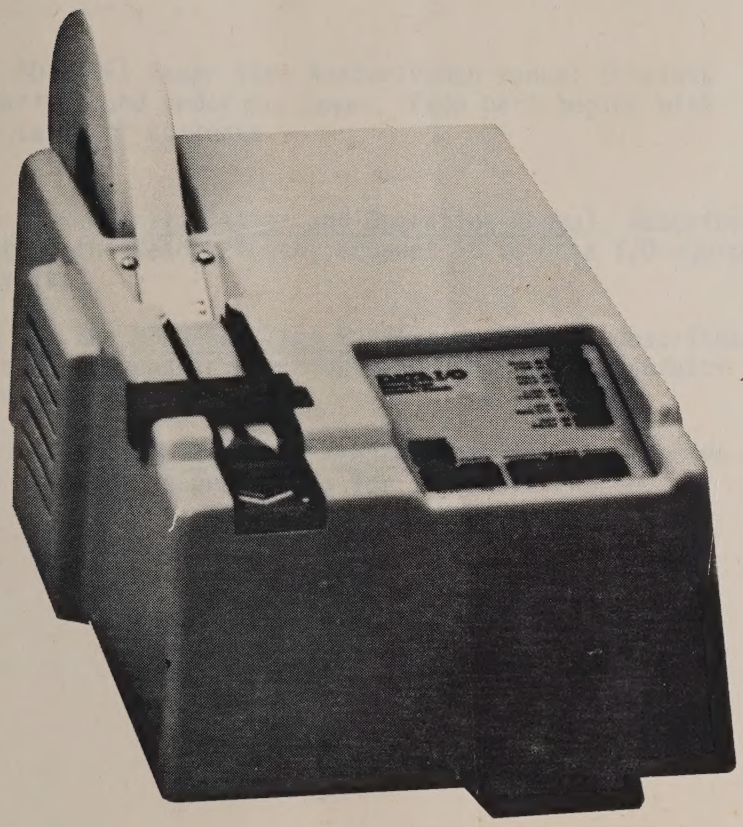
Instruction manual

DATA I/O



PAPER TAPE READER/ PUNCH

901-1951, 901-1952
901-1953, 901-1954

J26-1951 REV A AUG 79

FOREWORD

This 901-1951 Paper Tape Reader/Punch manual consists of three parts bound under one cover. Each part begins with a separate table of contents.

Part I, the Installation and Operating Manual, describes how to install the Reader/Punch, connect it to Data I/O equipment, and operate it.

Part II, the MODUPERF Tape Perforator Manual, describes operating and maintenance procedures for the tape-perforator mechanism of the Reader/Punch.

Part III, the Maintenance Manual, describes preventive and corrective maintenance procedures for the Reader/Punch.

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PART 1

INSTALLATION AND OPERATING MANUAL

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1. GENERAL NOTES

1.1 SCOPE

This manual is a guide to the simple procedures required to install and operate the 901-1951 product series. It applies to the following models:

901-1951
901-1952
901-1953
901-1954

In this manual the Reader/Punch will be called the 901-1951 for convenience, but this name should be understood to represent all 4 configurations.

1.2 GENERAL DESCRIPTION

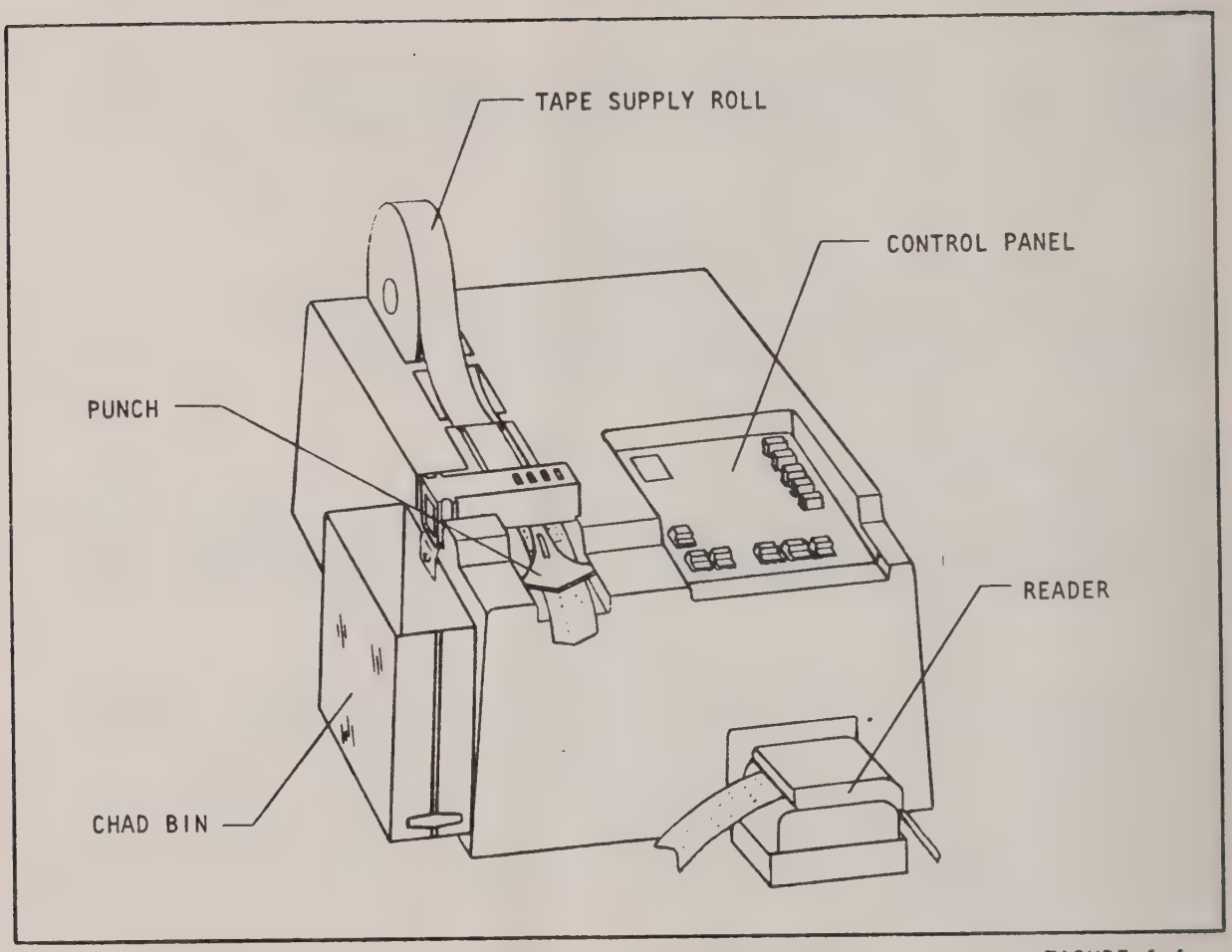
The 901-1951 Reader Punch Combo is a self-contained table top unit that has been designed to provide paper tape I/O capabilities for teleprinter and CRT terminals. The device has a RS 232C/CCITT V.24 interface and can transmit and receive at two switch selectable speeds of typically 110 baud (11 bit) and 300 baud (10 bit) ASCII code.

The Combo may be used off-line to prepare, edit and duplicate tapes. The search/edit/skip control may be used to single step the reader or alternately, continuous step until the button is released or carriage return is detected. Controls such as punch back-space, remote control and print offer operator flexibility and convenience when editing tapes. On-line the unit may be operated as a stand alone tape terminal or in conjunction with other terminals in either full or half-duplex modes (Switch selectable). The unit also detects the control codes DC1-DC4, thereby allowing complete control of the punch and reader from the tape, keyboard or remote terminal.

In addition, the 901-1951 is programmable for 5 Channel Baudot tapes, Echoplex instead of Full Duplex, 45 to 300 Baud, and 7 to 11 unit code.

The 901-1951 is packaged in an attractively styled cabinet which consumes only 13 inches of table width. Operator controls are conveniently located, punched tape exits toward the operator and the front mounted reader transports tape from left to right. For ease of service, the unit consists of five modules; punch, reader, power supply, control panel, and logic/driver board. Loosening 3 screws allows easy removal of the cover and excellent accessibility to all five modules.

Tape is perforated with the revolutionary "MODUPERF" mechanism which features whisper quiet operation and a modular design that allows the die block and/or data selector to be replaced in less than a minute.



901-1951

FIGURE 1-1

1.3 UNPACKING

The 901-1951 was inspected and tested both electrically and mechanically before it was shipped. Proper adjustment was made for the intended line voltage. For trouble-free initial operation, it is important to verify that the equipment is in the best possible condition upon receipt.

The 901-1951 was carefully packaged to prevent any possible shipping damage. It should, therefore, arrive free of any defect, electrical or mechanical, without marks or scratches, and in perfect operating condition. Carefully inspect the unit for any damage that may have occurred in transit, and also check that the accessories listed in Table 2-1 are present. If any physical damage is noted, file a claim with the carrier and notify Data I/O.

1.4 STORING AND SHIPPING

If the unit is not to be put into operation until some future time, re-package it using the original packing materials. The 901-1951 may be stored under any of the following conditions:

Temperature:	-40° to 66°C (-40° to 151°F)
Relative Humidity:	5% to 95% Non-condensing

Should it become necessary to ship the 901-1951, carefully pack the equipment in a suitable container to avoid damage during transit. Whenever possible, the original shipping container from the factory should be used. If other containers are utilized, a procedure similar to the original factory packaging should be followed. (See section 1.3 for container description).

CAUTION

DO NOT package the equipment in a rigid container without utilizing shockmounts or shock absorbant packing material. A rigid container will allow shock on the outside to be transmitted undamped to the unit which may cause damage.

Empty the chad bin before the unit is packed for shipment. Also empty the chad chute and close its opening with masking tape (or equivalent). This will prevent chad from spreading throughout the equipment during shipment.

2. INSTALLATION

2.1 GENERAL

The 901-1951 should be installed in an area that is free of excessive dust, dirt, corrosive fumes, and vapors. To insure that the unit has proper ventilation and cooling, the ventilation openings on the bottom and the left side of the cabinet should not be obstructed. It is NOT recommended that any padding or cushioning material be placed under the unit, as this could restrict the air flow. The unit may be installed on any solid, level surface of sufficient size to accommodate the physical dimensions of the unit. The area or enclosure in which the 901-1951 will operate has to meet the following environmental conditions:

Temperature:	5° to 40°C (41° to 104°F)
Relative Humidity:	5% to 95% Non-condensing

2.2 CONFIGURATIONS

After unpacking the 901-1951, look at the identification label on the back of the unit. Be sure that the configuration number listed on the label matches the configuration of equipment which you ordered. Figure 2-1 identifies the components of each configuration.

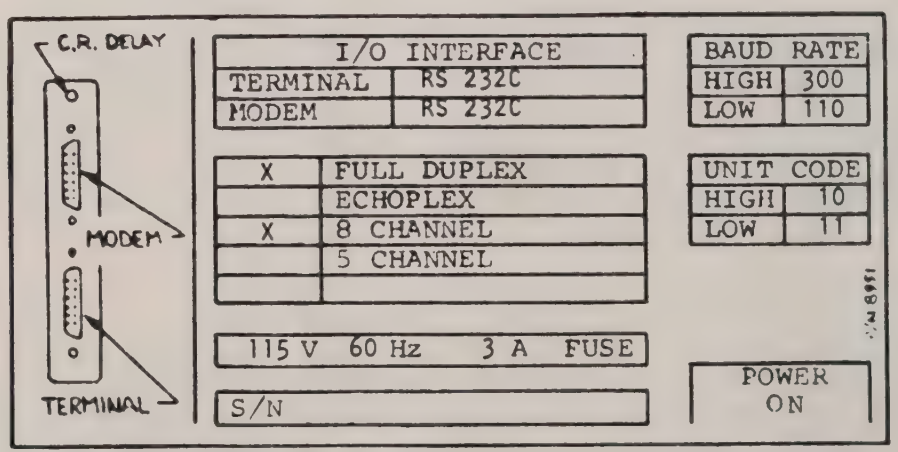
CONFIGURATION		INCLUDED PARTS
901-1951	920-1951	Paper Tape Reader Punch, 110V
	709-1951	Cable with 25-pin cannon connectors
	026-1951	Instruction manual
901-1952	920-1951	Paper Tape Reader Punch, 110V
	709-1952	Cable with 24-pin ribbon connector
	026-1951	Instruction manual
901-1953	920-1952	Paper Tape Reader Punch, 220V
	709-1951	Cable with 25-pin cannon connectors
	026-1951	Instruction manual
901-1954	920-1952	Paper Tape Reader Punch, 220V
	709-1952	Cable with 24-pin ribbon connector
	026-1951	Instruction manual

Standard Equipment

Table 2-1

Each unit may be programmed to 8/5 channels, different baud rates, Full/Echoplex etc. The programmed setting is marked on a label attached to the rear side of each unit. For example, Figure 2-1 illustrates the program setting of a standard 901-1951.

Programming instructions are beyond the scope of Part I. They are contained in Part 3.



PROGRAMMING LABEL

FIGURE 2-1

2.3 POWER INTERFACE

Before making any power line connection, place the power switch (shown in fig. 2-2) in the "OFF" position. The AC power cord extends from the rear of the cabinet and is terminated in a three-prong male, US type plug for connection to a grounded AC power receptacle.

CAUTION Make sure the available AC power matches the voltage and frequency requirements of the unit.

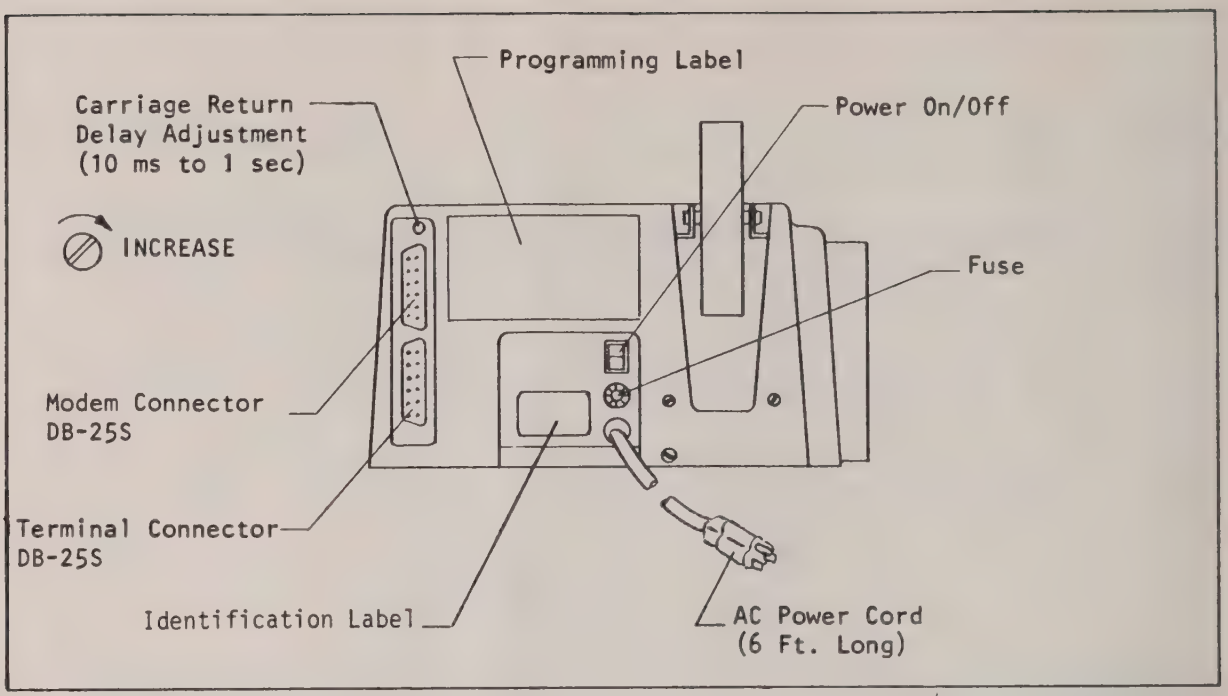
These requirements and the proper fuse values are shown on a label on the rear of the cabinet. The specified voltage should be met within ±10%, the frequency within ±2 HZ.

NOTE 230V 50HZ units are programmable for 215 Volt +10% -8% (198V minimum) for low voltage areas. See Part III for instructions.

NOTE All units, US and overseas market, are supplied with the same international color coded power cord:

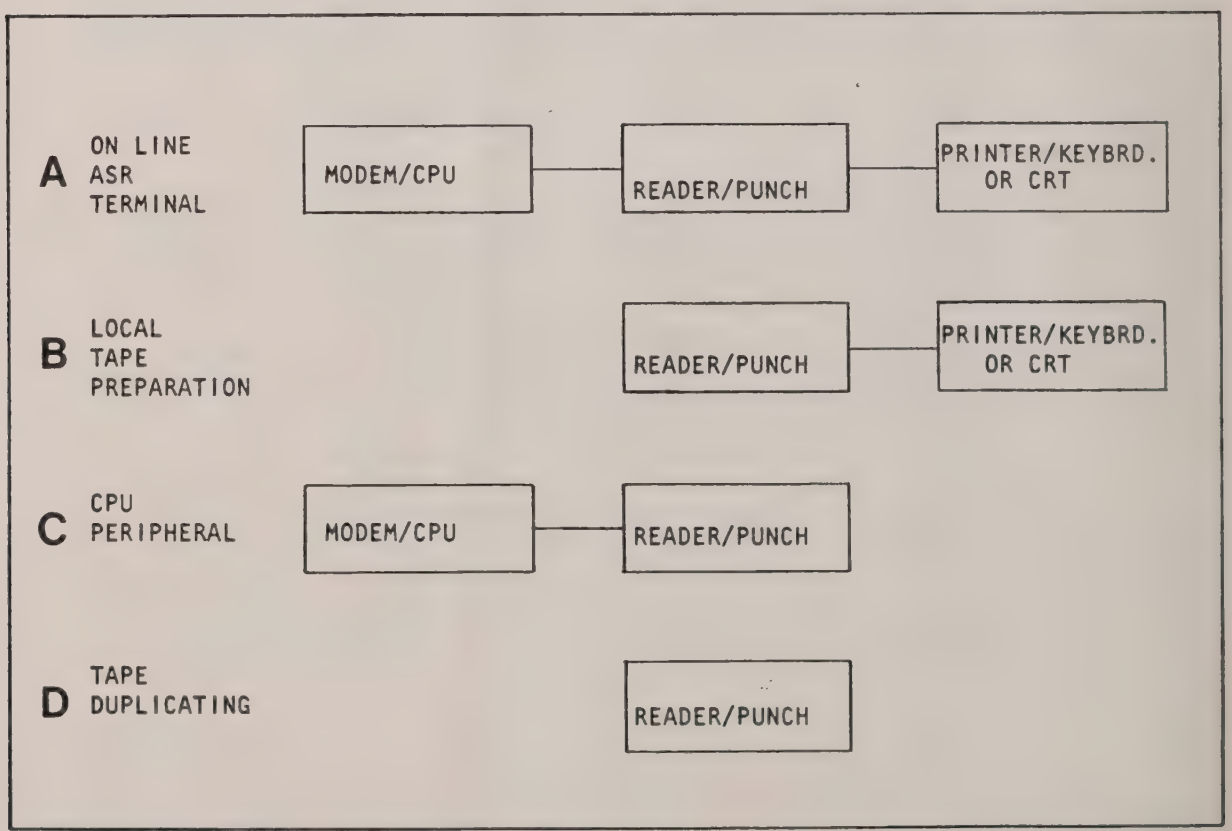
BROWN	- HOT
BLUE	- NEUTRAL
GREEN w/YELLOW	- FRAME GROUND

If a different plug is required, cut off the US type plug and replace it with a locally obtainable plug.



901-1951 Rear View

Figure 2-2



TYPICAL INSTALLATIONS

Figure 2-3

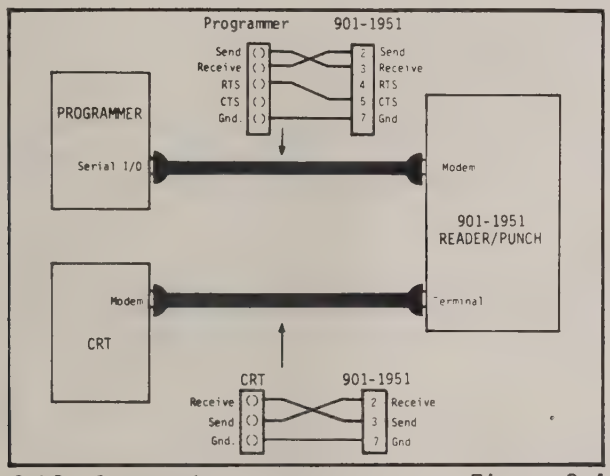
2.4 INTERFACING THE 901-1951 TO THE PROGRAMMER

2.4.1 CABLING

The 901-1951 interfaces with the following Data I/O programmers: Models 5, 7, 9 and 16 and the System 17 and 19. This interface is customarily between the programmer's serial-I/O port and the modem port of the 901-1951.

Figure 2-4 illustrates the required cable connections for interfacing the 901-1951 to both the programmer and a CRT. The cabling is as shown below whether the 901-1951 is connected to one of the two instruments or both.

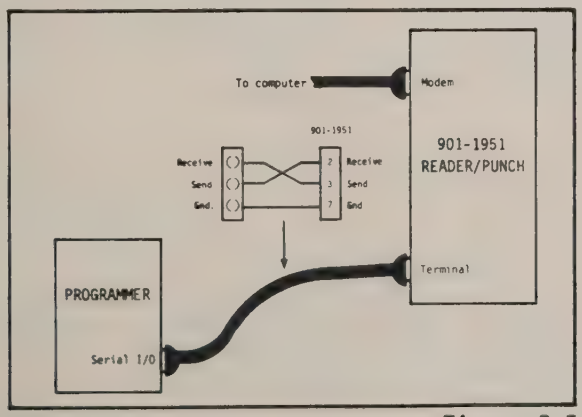
NOTE
The cable shown for the programmer/901-1951 interface is supplied by Data I/O. The CRT/901-1951 interface is not supplied.



Cable Connections Figure 2-4

In this configuration, data output from the programmer can be punched by the 901-1951 and displayed at the CRT, or data on paper tape can be input to the programmer and displayed on the CRT.

An alternate configuration of the programmer and the 901-1951 frees the modem port of the 901-1951 to connect to a computer. See Figure 2-5.



Alternate Cabling Figure 2-5

NOTE
This alternate interconnection cable is not supplied.

Note, however, that in this configuration the programmer cannot stop an input tape at the end of the data because the RTS line is not available on the terminal port of the 901-1951.

Paragraph 2.5 defines each connected pin of the 901-1951's terminal and modem connectors.

The I/O connections to the modem and terminal are provided by two 25 pin connectors. See figure 2-2 for location and connector specifications. Figure 2-3 illustrates the four typical ways the 901-1951 can be connected to other devices.

2.4.2 DATA-TRANSFER PARAMETERS

To prepare for an input or output operation between the 901-1951 and the programmer:

a. Set up the programmer for 300 baud. See the programmer manual.

b. Set the 901-1951's stop bits for compatibility with the programmer.

c. Set the programmer to no parity.

To transfer data between the 901-1951, the programmer and a CRT in the configuration of Figure 2-4, set the top-panel switches on the 901-1951 to the following settings:

High/Low	to	HIGH
Full/Half	to	HALF
Line/Local	to	LINE
Remote Control	to	OFF
Printer ON/OFF	to	ON

To transfer data between the 901-1951 and the programmer in the configuration of Figure 2-5, set the top-panel switches on the 901-1951 to the following settings:

High/Low	to	HIGH
Full/Half	to	HALF
Line/Local	to	LOCAL
Remote Control	to	OFF
Printer ON/OFF	to	ON

2.5 RS 232C INTERFACE

This Interface conforms to EIA RS 232C and CCITT V.24 specification.

ON or SPACE condition: +3 to +25 VDC
OFF or MARK condition: -3 to -25 VDC

TERMINAL INTERFACE: DB 25S Connector

PIN NO.	SIGNAL	DEFINITION
2	Data From Printer (Receive)	This lead is the EIA serial data input to the unit from the printer. Data on this lead will be fed to the punch, character detection logic, or sent on-line as selected by the controls.
3	Data to Printer (Send)	This lead is the EIA serial data output to the printer. When the Printer is deselected, this lead will be held in the EIA "OFF" state.
5	Clear to Send	This lead can be used to drive the printer's clear to send input to the "ON" condition and allow it to transmit data. This output is always in the EIA "ON" condition.
6	Data Set Ready	This lead can be used to drive the printer's Data Set Ready input to the "ON" condition and allow it to communicate. This output is always in the EIA "ON" condition.
7	DC Ground	This lead serves as the voltage reference between the interfaced devices (0 Volts).
8	Carrier Detect	This lead can be used to drive the printer's carrier detect lead to the "ON" condition and allow the printer to receive data. This lead is always in the EIA "ON" condition.
1, 4, 9-25		Not connected

MODEM INTERFACE: DB 25P Connector

PIN NO.	SIGNAL	DEFINITION
2	Transmitted Data	This is the EIA serial data output of the unit. When the 901-1951 is in the LOCAL mode, this lead is held in the EIA "OFF" state.
3	Received Data	This lead is the EIA serial data input to the 901-1951 from the modem. When the 901-1951 is in the LOCAL mode, this input is ignored.

4	Request to Send	This lead is an output of the 901-1951. It is in the "ON" state when the unit is in the LINE mode and the reader switch is ON. RTS is in the "OFF" state when the unit is in LOCAL mode and/or the reader switch is OFF.
5	Clear to Send	This input lead can be used to control the 901-1951 reader. When this lead is left unwired or driven to the "OFF" state, the reader will be inhibited from sending. When this lead is driven to the EIA "ON" state, the reader will be enabled.
7	DC Ground	This lead serves as the voltage reference between the interfaced devices (0 Volts).
20	Data Terminal Ready	This output lead indicates whether the 901-1951 is in the LINE or LOCAL mode. When the unit is in the LOCAL mode and will not communicate on the modem port, the Data Terminal Ready lead is held at EIA "OFF". When the unit is in the LINE mode, this lead is in the EIA "ON" state.
1, 6, 8-19, 21-25		Not connected

2.6 SETTING OF CARRIAGE RETURN DELAY

This section is only applicable if the 901-1951 is connected to a printer without data buffer and which needs more than one character cycle for carriage return. Disregard this section if the utilized printer has a data buffer (DECWRITER or MODEL 43 TELETYPE for example).

Normally, printers without data buffers require fill characters located after carriage return in the punched tape. While these fill characters are read, the printer has time to go through its carriage return cycle. The 901-1951 has an automatic carriage return delay feature. When the reader detects a carriage return character, the reading of the following character is delayed by an adjustable interval of 10 ms to 1 second. This feature eliminates the need for fill characters.

To adjust, turn the delay potentiometer (see fig. 2-2) all the way clockwise, its 1 second position (factory setting: 10 ms.). Then transmit a message from the reader to the printer which uses the full length of the print lines (max. carriage return time). Now, as the message is being printed, line by line, observe the hesitation of the print head carriage just after it completes a carriage return. Slowly turn the delay potentiometer counter clockwise until the hesitation is reduced to a just noticeable amount. The 901-1951 is now adjusted to yield maximum thruput with this particular printer.

3. OPERATING GUIDE

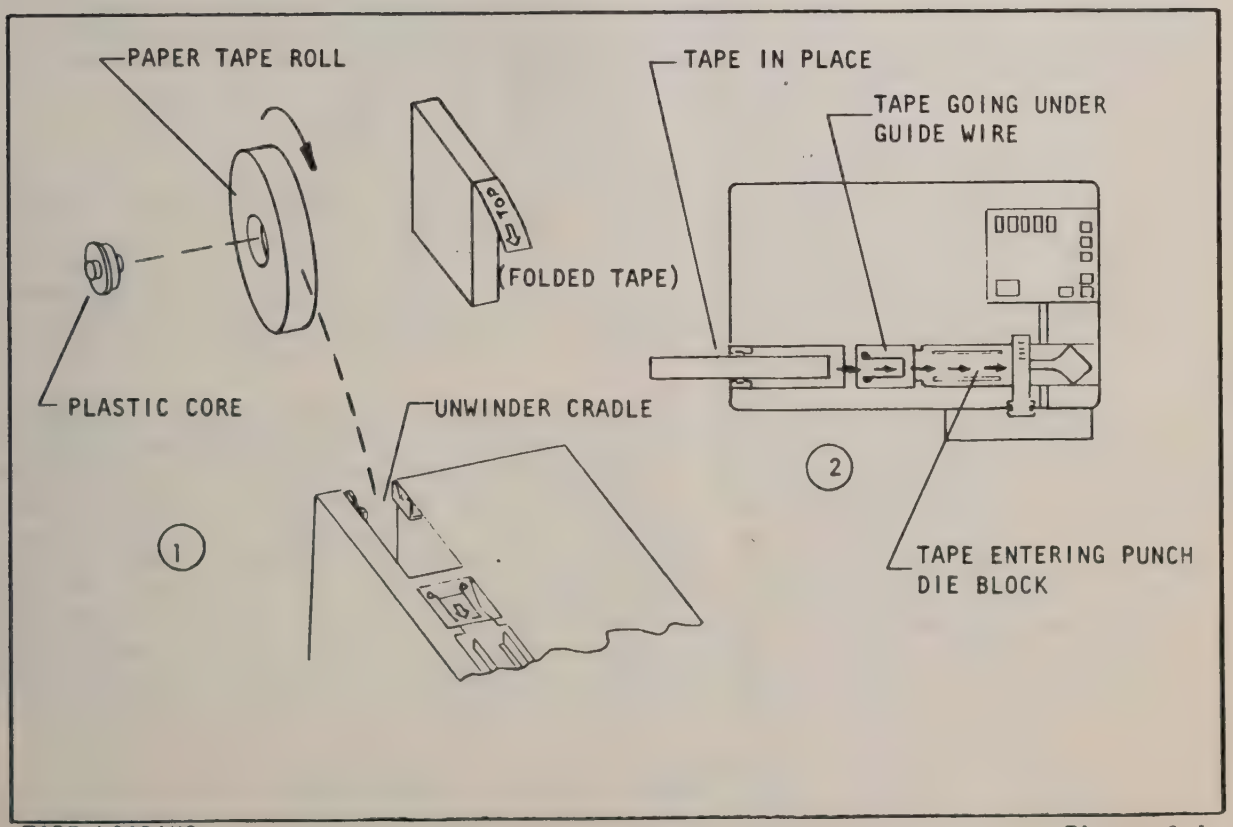
3.1 TAPE LOADING - ROLLS

The unit will accommodate tape rolls with a two inch core diameter and up to eight inches outside diameter. See section 4.1 for recommended tape materials.

Refer to figure 3-1 and label on unit when following this procedure:

a. Check the roll of tape to be certain that it is flat and not distorted or "coned" in the center. If this distortion does exist, lay the roll on a flat surface and push downward to force the distorted areas back into place. Do not break the seal on the roll at this time.

b. Put the plastic core in to the roll and place core in unwinder cradle as illustrated.



TAPE LOADING

Figure 3-1

c. Break the seal on the tape roll, tearing (or cutting) off the first layer of tape and making sure the segment of tape that was glued is removed. This will prevent undue difficulty in threading the tape through the punch block. When tearing off the leading edge of the tape, attempt to make the tear as even as possible, or scissors should be used to assure a clean cut.

d. Route the tape under the tape guide wire and through the slot in the die block as illustrated. The TOP and ⟹ on printed tape (when used) will show now on top.

e. Now, with the POWER switch in the ON position, with one hand push the tape further forward until the leading edge butts up against the feed sprocket; at the same time depress the FEED switch with the other hand. As you continue to push the tape forward, the feed sprocket will become engaged with the tape and pull it through the machine. Continue to depress the FEED switch until approximately 1 foot (30 cm) of tape hangs from the front of the unit. The unit is now ready for operation.

3.2 TEARING OFF TAPE

To tear off (or cut off) punched tape, it may be desirable to push the FEED control button to allow some additional tape at the end of the punched message. Holding the tape firmly, pull the tape quickly upward and slightly toward the back of the machine. The cutting blade will then sever the tape easily. Do not attempt to tear off the tape by pulling it to one side or the other. The cutting blade can not work most efficiently when used in this manner.

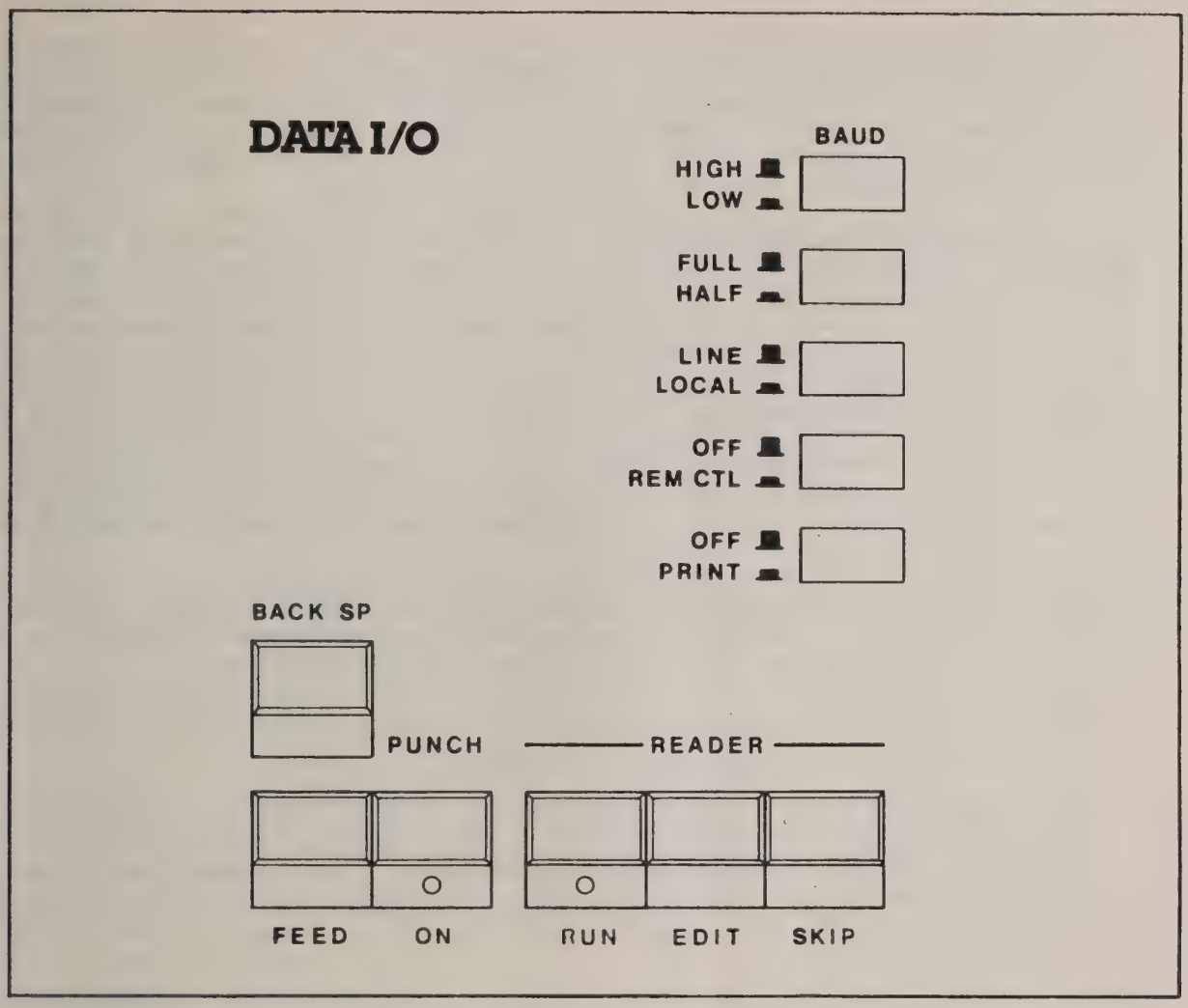
3.3 CONTROLS AND INDICATORS

Figure 3-2 illustrates the controls and indicators on the 901-1951, except the power switch which is located on the rear side of the unit.

POWER ON/OFF switch. This switch controls the AC power to the unit. When the unit is first powered up, the PUNCH ON switch will automatically come up in the ON state (LED on), the READER RUN switch will come up in the OFF state (LED off).

LOW/HIGH BAUD switch. The rate at which characters are transmitted and received by the reader and punch is controlled by this switch. LOW - 110 Baud (10 char/sec), HIGH - 300 Baud (30 char/sec). 110 and 300 baud are the standard settings of the 901-1951. Check programming label on rear of unit for other baud rate settings.

FULL/HALF DUPLEX switch. In half duplex operation, only the data transmitted by the reader may simultaneously be received by the punch. In full duplex the punch and reader may receive and transmit different data simultaneously and independently from each other.



CONTROLS AND INDICATORS FIGURE 3-2

If the 901-1951 is programmed for ECHOPLEX in lieu of FULL DUPLEX, the received data will be transmitted (echoed) back to the modem.

LINE/LOCAL switch. When this switch is in the LINE position, data may be transmitted and received through the modem port of the 901-1951. In the LOCAL mode the receive/transmit lines of the modem port are disabled and only local operation can be performed.

REMOTE CONTROL switch. When this switch is ON the unit may be controlled from a remote terminal operating in full duplex with the 901-1951. The reader and punch will turn on and off in response to the following control codes:

Function	ASCII Code
Reader Start	DC1
Punch Start	DC2
Reader Stop	DC3
Punch Stop	DC4

When the 901-1951 is operated in half duplex with a remote terminal or is operated locally with a printer for example, DC1, DC2, and DC4 may still be sent from the remote terminal or the keyboard as long as the reader is off. Once the reader is on, it cannot be stopped by a remote DC3 received in the half duplex or local mode. But a DC3 code read by the reader itself will stop it just as a DC2 or DC4 read by the reader will turn the punch on and off.

With the REMOTE CONTROL switch ON, when a DC2 is received and the punch is ON, the DC2 control character will be punched. If the punch is OFF, a DC2, when received, will not be punched. A DC4 will never be punched when Remote Control is ON. All DC2, DC4 control characters will be punched when Punch is ON and Remote Control is OFF. DC1 and DC3 will be punched if they are received while the punch is on. When the REMOTE CONTROL switch is OFF the reader and punch will not respond to the control characters other than reading and punching them as any other characters.

PRINT ON/OFF switch. This switch controls transmitted and received data through the printer port of the 901-1951. For example, when the switch is ON, data being punched is also transmitted to a connected page-printer. In the OFF state, no data is transmitted or received through this port.

PUNCH ON switch with INDICATOR. A momentary depression of this switch will enable or disable the punch. The ON (enabled) state is indicated by a lit LED. This switch has to be ON before the punch can respond to any data input.

PUNCH FEED switch. Depression of this switch results in the punch feeding out tape with NULL characters (feedholes punched only) at approximately 34 cps. The feed out will stop when the switch button is released.

PUNCH BACKSPACE switch. A momentary depression of this switch will cause the tape in the punch to backspace by one character. The switch button has to be released and depressed again for another backspace character. This sequence may be repeated for up to 50 characters. If the backspaced tape is guided and taken up manually to prevent tangling of the tape, an unlimited number of backspace sequences may be performed.

READER RUN switch with INDICATOR. A momentary depression of this switch will cause the reader to start reading tape at the selected baud rate. The ON state is indicated by a lit LED. A second momentary depression will cause the reader to stop (LED off).

READER EDIT switch. This is a very powerful control switch which has three functions: First, a short momentary depression of less than 1/2 second duration will cause the reader to advance one step, i.e. read one character. Second, holding the switch button depressed will cause the reader to search until a Carriage Return character is detected; the reader will then stop. To restart, the switch button has to be released and depressed again. Third, the release of the button prior to detection of a Carriage Return character will stop the reader also.

READER SKIP switch. This momentary switch has the same three functions as the EDIT switch except no data is transmitted from the reader. In other words, its effect is only mechanical motion of the tape through the read head.

CARRIAGE RETURN DELAY. This control, located on the rear side of the unit (see fig. 2.2), should be disregarded if the 901-1951 is connected to a printer with data buffer, a DECWRITER for example. With printers without data buffer, this automatic time delay following a carriage return eliminates the need for fill characters. It is

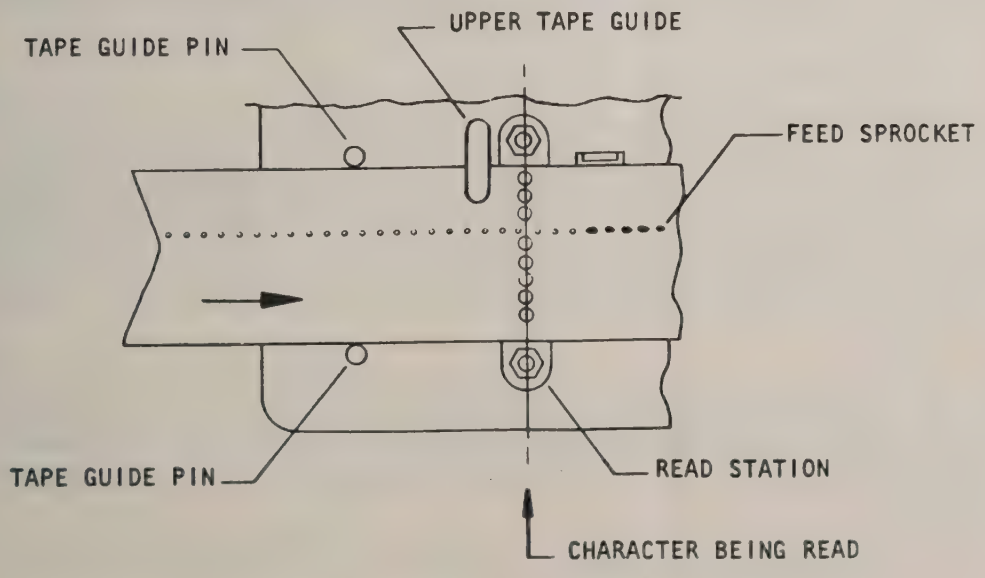
adjustable from 10 ms to 1 second. See section 2.7 for a detailed description of setting this control. When duplicating tapes in the LOCAL mode with the PRINT Control off, the delay is automatically set to zero, thereby improving thru-put.

3.4 TAPE READER

The 901-1951 utilizes an optical tape reader with a sprocket drive which moves the tape from left to right. To LOAD TAPE in the reader: raise the lid to expose the read station, slide the tape under the upper tape guide and between the tape guide pins (see figure 3-3), engage the feedholes with the drive sprocket and lower the lid carefully. The tape is now ready to be read.

When making tapes, it is advisable to precede any data with enough leader tape so no character alignment is necessary when loading tape in the reader. The reader operates in the READ-FEED mode. A character is first read and then the tape is advanced until the next character is in alignment with the read station. If it is necessary to read a particular character, align the character to be read with the read station when loading the tape.

It is advisable to use only good quality tapes. See section 4.1 for recommended materials. Transparent spots, uneven density and width out of tolerance, typically associated with substandard tapes, may cause reader errors.

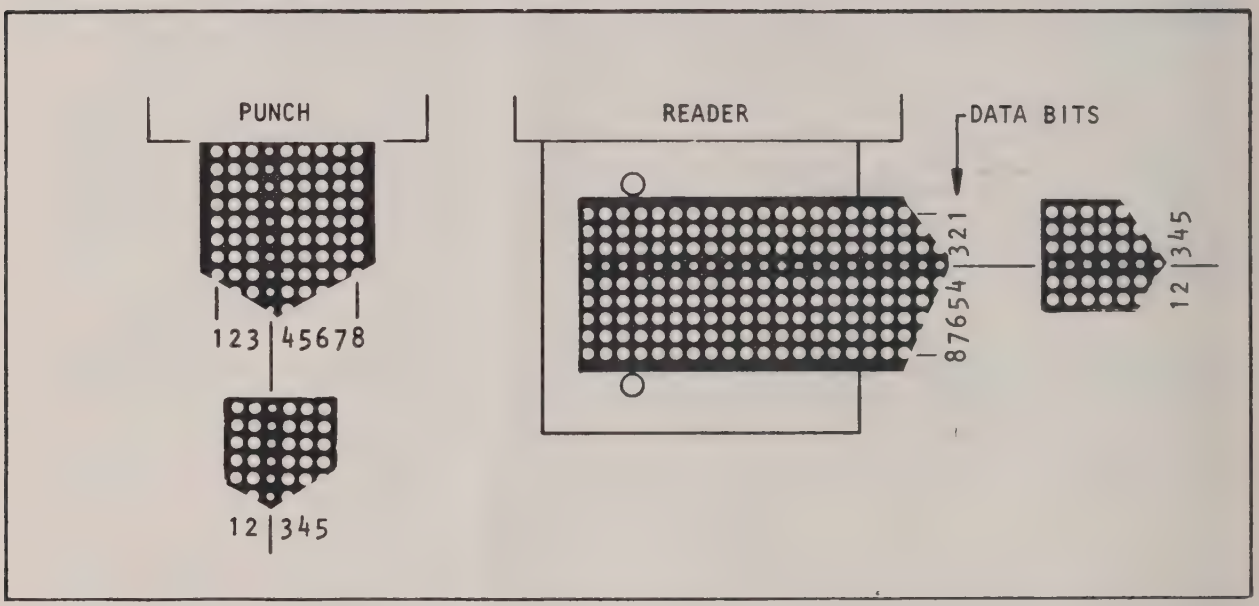


READER

FIGURE 3-3

3.5 TAPE ORIENTATION/BIT ASSIGNMENT

Figure 3-4 illustrates orientation of the tape in the punch and reader for 8 and 5 channel tape.



TAPE ORIENTATION/BIT ASSIGNMENT FIGURE 3-4

3.6 TAPE PERFORATOR

The perforator utilized in the 901-1951 is the MODUPERF mechanism. This is an extremely quiet, long life unit. The tape is advanced not with a capstan but with a sprocket wheel. This means NO ADJUSTMENTS are necessary when switching between different kinds of paper tapes. The feeding accuracy is not affected by different thicknesses or surface textures of the tape. The perforator also has a LAST CHARACTER VISIBILITY feature. The unit operates on a punch-feed cycle and the die block is constructed such that the last character punched is always visible.

No take up spooling is provided for the punch or reader. Short tapes are typically taken up by hand or the tape is accumulated in a suitable container such as a box, wastebasket, etc. Avoid spilling the tape on the floor where it is prone to pick up dirt or get damaged. For longer tapes, floor mounted power winders are recommended.

3.7 TYPICAL APPLICATIONS

PREPARING TAPE WITH LOCAL KEYBOARD/PRINTER:
Put the controls on the keyboard/printer in the LINE and FULL DUPLEX mode. Set the 901-1951 on LOCAL, FULL or HALF DUPLEX, BAUD rate to match keyboard/printer, PUNCH ON, and PRINT ON. Data from the keyboard will now be punched and printed.

If a typing error occurs, the tape can be corrected in the following manner. Depress the BACKSPACE button on the 901-1951. Each depression will cause the tape to step one character backwards. If one character has to be corrected, backspace once; if five characters have to be corrected, backspace five times. Now depress the DELETE key on the keyboard of the printer. Each depression will cause a DELETE character to be punched; that is all 8 data holes will be punched and the character will be deleted. When the tape is read, the deleted characters will not be printed.

ON LINE WITH KEYBOARD PRINTER (ASR CONFIGURATION):
Set the controls of keyboard/printer to LINE and FULL DUPLEX. Set the 901-1951 on LINE, FULL DUPLEX, BAUD rate to match keyboard printer, PUNCH ON and PRINT ON. With the modem port of the 901-1951 connected to a modem, the equipment can now go on line in the full duplex mode, meaning different data may be received and transmitted simultaneously. When using the remote keyboard, the Echoplex mode is often used on the local 901-1951 for verification of transmitted data; data does not go directly from the remote keyboard to the remote printer, but is transmitted to the local 901-1951, reflected back and then received by the remote printer. This results in visual verification that the data has been correctly received by the local 901-1951. If the distant/remote terminal is not intended to transmit data (either verification reflection data or its own different data) then the 901-1951 may be set in the HALF DUPLEX mode so the local punch and printer can receive data from the local keyboard.

DUPLICATING TAPE:
Set the controls on the 901-1951 to HIGH (baud rate), PRINT OFF, FULL or HALF duplex, LOCAL and PUNCH ON. Depress PUNCH FEED button to generate desired length of leader. Load reader with tape to be duplicated. Depress READER RUN button to duplicate tape.

PRINTING FROM TAPE:
Controls of keyboard/printer are on LINE and FULL DUPLEX. The 901-1951 is set on LOCAL, HALF DUPLEX, BAUD rate to match keyboard/printer, and PRINT ON. Load reader with tape to be printed. Depress READER RUN button to print data from tape.

TAPE EDITING - DELETION OF CHARACTER:
To edit tapes the 901-1951 is connected to a keyboard/printer or keyboard/CTR terminal. Controls on this terminal are set to LINE and FULL DUPLEX. The 901-1951 is in LOCAL, FULL or HALF DUPLEX, BAUD rate to match terminal, PUNCH ON, and PRINT ON. Load the reader with the tape to be edited. Use the READER RUN and/or EDIT control to read (print and duplicate) the tape. Stop the reading of the tape just before the character to be deleted. Depress the SKIP button to skip over the character (will not be punched). Duplicate rest of tape by depressing the READER RUN button.

TAPE EDITING - ADDITION OF CHARACTER:
Set the controls as above. Load the reader with the tape to be edited. Use the READER RUN and EDIT control to read (print and duplicate) the tape until the spot where a new character should be added. Add the new character or characters via the keyboard. Duplicate the rest of the tape by depressing the READER RUN button.

TAPE EDITING - CHANGING OF CHARACTER:
This is a combination of deletion and addition of characters as described above.

TRANSMITTING/RECEIVING - DISTANT TERMINAL:
The 901-1951 is put in the LINE mode. FULL/HALF DUPLEX and HIGH/LOW baud rate are set as required. After going through the required hook-up sequence, the 901-1951 is ready to transmit and/or receive data by actuating the appropriate controls.

3.8 OPERATIONS

3.8.1 INPUTTING DATA TO THE PROGRAMMER

To input data from the 901-1951 to Data I/O programmers, complete the following steps:

a. Prepare data-transfer parameters according to paragraph 2.4.
b. Initiate an Input operation at the programmer (refer to the programmer's main instruction manual).
c. Insert tape into the reader and press the RUN key. The data will be read into programmer RAM.

NOTE

To input data with the ASCII instrument-control codes DC1 or DC3, the REMOTE CONTROL key on the 901-1951 must be ON.

3.8.2.OUTPUTTING DATA FROM THE PROGRAMMER

To output data from Data I/O programmers to the 901-1951, complete the following steps:

a. Prepare data-transfer parameters according to paragraph 2.4.
b. Push the FEED key on the 901-1951 to create a leader on the tape. Then press the ON key.
c. Initiate an Output operation at the programmer (refer to the programmer's main instruction manual). The tape will be punched with the output data.

NOTE

To output data with the ASC11 instrument-control codes DC2 or DC4, the REMOTE CONTROL key on the 901-1951 must be ON.

3.9 OPERATOR CARE

GENERAL - Do not use the cover to hold pencils, papers, paper clips, etc.
- Use only a lint free cloth to clean the 901-1951. Do not use solvents or harsh cleaning agents. If excessively dirty, a mild detergent solution or desktop cleaner may be used sparingly.

PUNCH - As required, clean die block area with a soft bristle brush.

READER - As required, remove any dirt/lint accumulations in the read station area and the LED's (underside of lid) with a soft bristle brush.

4. APPENDIX

4.1 RECOMMENDED TAPE MATERIALS

Unoiled colored or buff paper tape with a 55% Maximum Transmissivity is recommended. Black tape should be avoided since sometimes carbon dye is used which is very detrimental to the wear characteristics of the punch pins. The tape should be from a quality manufacturer and meet EIA Standard RS-227-A.

CAUTION: Oiled buff tape is not recommended. The 5 to 12% oil in these tapes sometimes causes highly transparent spots to occur. These spots, combined with the light yellow "buff" color, may exceed 55% light transmissivity and cause reader errors. While oiled tapes of grey and darker colors are acceptable since their transmissivity is well below 55%, the oil in the tape is of no value since it has an insignificant effect on the life expectancy of the MODUPERF punch head.

Paper tapes, if of poor quality, will cause problems in punching and/or reading. For example, the tape might have the following defects; transparent spots, width out of tolerance, splices in roll or roll not continuous, torn folds (fanfold), etc. Tapes of the suppliers listed below have been found acceptable. This list is not meant to be exclusive.

Arvey Corporation
3500 N. Kimball Ave.
Chicago, Ill. 60618
(312) 463-1400

Chase Foster
199 Amaral St.
East Providence, RI 02914
(401) 434-2340

Eastern Specialties
P.O. Box 350
Holyoke, Mass. 01040
(413) 533-7103

Numeridex, Inc.
241 Holbrook Drive
Wheeling, Ill. 60090
(312) 541-8840

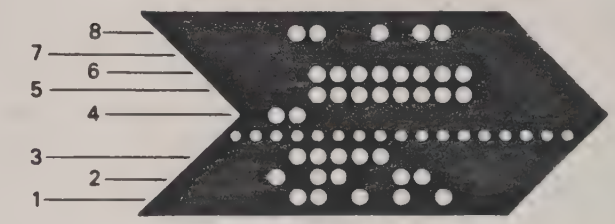
Occidental
1188 Montague View
San Leandro, Calif. 94577
(415) 352-3202

Paper Manufactures Company
9800 Bustleton Avenue
Philadelphia, Pa. 19115
(215) 673-4500

RIBCO
200 Railroad Avenue
Paterson, N.J. 07509
(201) 271-4848

4.2 ASCII CODE CHART AND TAPE SAMPLE

The sample tape is shown with leader (null) preceding and following the data. The point of the tape indicates direction of tape motion. Bit No. 8, while not defined by the ASCII Code, is used for even or odd parity or other checking schemes. The sample illustrates even parity. (see fig. 4-1)



ASCII

UNITED STATES OF AMERICA
STANDARD CODE
FOR INFORMATION INTERCHANGE
(X3.4-1967)

b_7 b_6 b_5 → / Bits b_4 b_3 b_2 b_1	COLUMN → / ROW ↓	0 (0 0 0)	1 (0 0 1)	2 (0 1 0)	3 (0 1 1)	4 (1 0 0)	5 (1 0 1)	6 (1 1 0)	7 (1 1 1)
0 0 0 0	0	NUL	DLE	SP	0	@	P	`	p
0 0 0 1	1	SOH	DC1	!	1	A	Q	a	q
0 0 1 0	2	STX	DC2	"	2	B	R	b	r
0 0 1 1	3	ETX	DC3	#	3	C	S	c	s
0 1 0 0	4	EOT	DC4	$	4	D	T	d	t
0 1 0 1	5	ENQ	NAK	%	5	E	U	e	u
0 1 1 0	6	ACK	SYN	&	6	F	V	f	v
0 1 1 1	7	BEL	ETB	'	7	G	W	g	w
1 0 0 0	8	BS	CAN	(	8	H	X	h	x
1 0 0 1	9	HT	EM	)	9	I	Y	i	y
1 0 1 0	10	LF	SUB	*	:	J	Z	j	z
1 0 1 1	11	VT	ESC	+	;	K	[	k	{
1 1 0 0	12	FF	FS	,	<	L	\	l	|
1 1 0 1	13	CR	GS	-	=	M	]	m	}
1 1 1 0	14	SO	RS	.	>	N	^	n	~
1 1 1 1	15	SI	US	/	?	O	_	o	DEL

ASCII CODE CHART AND TAPE SAMPLE — Figure 4-1

PART 2

MODUPERF TAPE PERFORATOR MANUAL

901-1951
PART II

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1. SCOPE

This document is intended to assist the technician in maintaining the MODUPERF Tape Perforator Mechanism. Instructions include preventive and corrective maintenance procedures. These should be thoroughly understood before attempting to service the equipment.

2. GENERAL NOTES

2.1 UNPACKING INSTRUCTIONS

When removing the Perforator Mechanism or other maintenance parts/modules from the carton, be careful not to lift or carry the mechanism by fragile parts which could be damaged. The units have been carefully tested, inspected, and packed to insure arrival in good condition.

Inspect the unit immediately after removal from the packing container to determine if any damage has occured in transit. In the event the equipment has been damaged as a result of shipping, the carrier and Data I/O must be notified immediately.

2.2 PACKING INSTRUCTIONS

If the instrument is to be shipped to Data I/O for service or repair, attach a tag to it describing the work required and identifying the owner. In correspondence, identify the unit by serial number, model number and name.

If the original shipping container is to be used, place the instrument in the container with appropriate packing material and seal the container well, with strong tape. If some other container is used, be sure that it is a heavy carton, wrapped with heavy paper or plastic; use appropriate packing material and seal well with strong tape. Mark the container "DELICATE INSTRUMENT" or "FRAGILE."

DO NOT package any equipment in a rigid container without utilizing shockmounts or shock absorbant packing material. A rigid container will allow shock on the outside to be transmitted undamped to the mechanism which may cause damage.

Before a complete perforator mechanism or a die block module is packaged, the chad chamber above the die block should be cleared of chad. This will prevent chad from spreading thruout the unit during the shipment.

2.3 RECOMMENDED TAPE MATERIALS

PAPER TAPE: Oiled* or unoiled colored or buff tape is recommended. Black tape should be avoided since sometimes carbon dye is used which is very detrimental to the wear characteristics of the punch pins. The tape should be from a quality manufacturer and meet EIA Standard RS-227-A.

*CAUTION: Oiled buff tape is not recommended if the tape will be read with a photo-optical reader. The 5 to 12% oil in these tapes sometimes causes highly transparent spots to occur. These spots, combined with the light yellow "buff" color, may exceed 55% light transmissivity and cause reader errors. While oiled tapes of gray and darker colors are acceptable since their transmissivity is well below 55%, the oil in the tape is of no value since it has an insignificant effect on the life expectancy of the MODUPERF punch head.

LIFE EXPECTANCY OF PUNCH HEAD:

Paper Tape; any color
but black — 500,000 feet of tape

PAPER tapes, if of poor quality, will cause problems in punching and/or reading. For example, the tape might have the following defects; transparent spots, width out of tolerance, spliced in roll not continuous, torn folds (fanfold) etc. The tapes of the suppliers listed below have been tested and found to be acceptable. This list is not meant to be exclusive.

Arvey Corporation
3500 N. Kimball Ave.
Chicago, IL 60618
(312) 463-1400

Chase Foster
199 Amaral St.
East Providence, RI 02914
(401) 434-2340

Eastern Specialties
P.O. Box 350
Holyoke, MA 01040
(413) 533-7103

Numeridex, Inc.
241 Holbrook Drive
Wheeling, IL 60090
(312) 541-8840

Occidental
1188 Montague View
San Leandro, CA 94577
(415) 352-3202

Paper Manufacturers Company
9800 Bustleton Avenue
Philadelphia, PA 19115
(215) 673-4500

Ribco
200 Railroad Avenue
Paterson, NJ 07509
(201) 271-4848

2.4 DEFINITIONS OF REFERENCES

References made to "Left", "Right", "Up", "Down", "Front", "Rear", etc. apply to the unit in its normal operating position as viewed from the front, ie; the tape moves from left to right, and code level 1 on the tape is nearest to the front.

2.5 LOCATION OF SERIAL NUMBERS

The Data I/O 950-1951 has a serial number located on the label on its back panel. Use this number in correspondence with Data I/O regarding the equipment.

The perforator mechanism consists of 3 main modules, the main frame module, the selector module, and the die block module. Each module has a unique serial number. The serial number of the main frame module is also used to define the complete perforator mechanism. For example, a perforator mechanism with a main frame module S/N 1234 is defined as perforator mechanism S/N 1234. The serial numbers are located as follows:

MAIN FRAME MODULE
Rear View

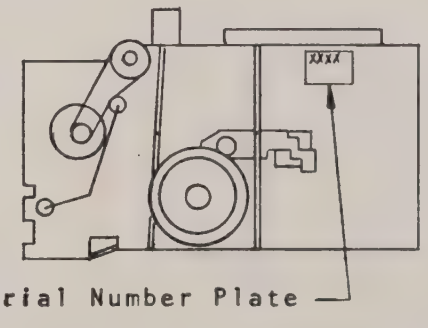


Figure 2-1

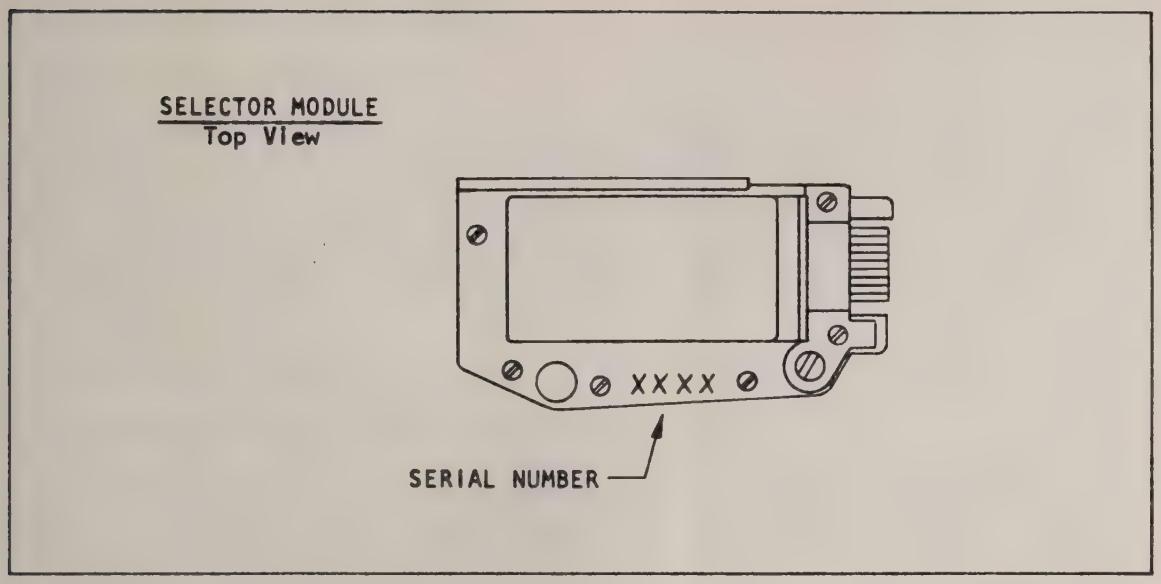


Figure 2-2

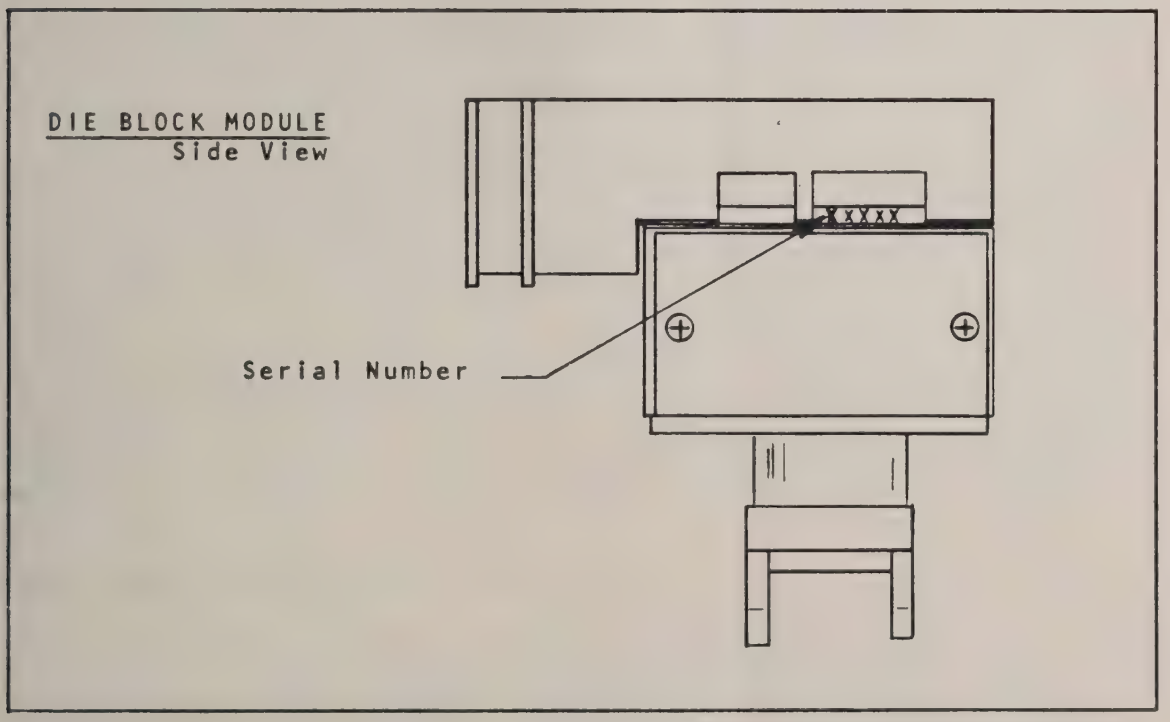


Figure 2-3

3. OPERATIONAL DESCRIPTION

3.1 OUTLINE OF OPERATION

The **MODUPERF** Tape Perforator is a device which perforates holes in paper tape in response to electrical drive signals. Electrical pulses received by the selector module are converted into a mechanical arrangement of the selecting slides. These slides engage with the punch pins and are driven through the paper by a motor. After punching the tape is advanced by a stepper motor.

3.2 DETAILED OPERATION

3.2.1 PUNCH PIN SELECTION (see Figure 3-1)

The code channels and feed track punches are selected by the selector module. The selecting module consists of electromagnets and selecting slides. There is one electromagnet (coil) and one selecting slide for each punch pin.

When a coil is activated by an electrical signal, an armature lever is drawn to the core of the coil. Attached to the armature lever is a wire which engages with a selecting slide. As the armature lever is drawn in to the core, the wire moves the selecting slide to the right where it engages with the punch bar.

Once the hole has been punched (see Section 3.2.2) and the next tape position does not call for a hole, the selecting coil is deactivated and the selecting slide disengages the punch bar by moving to the left. If consecutive holes are being punched, the selecting slide stays engaged with the punch bar.

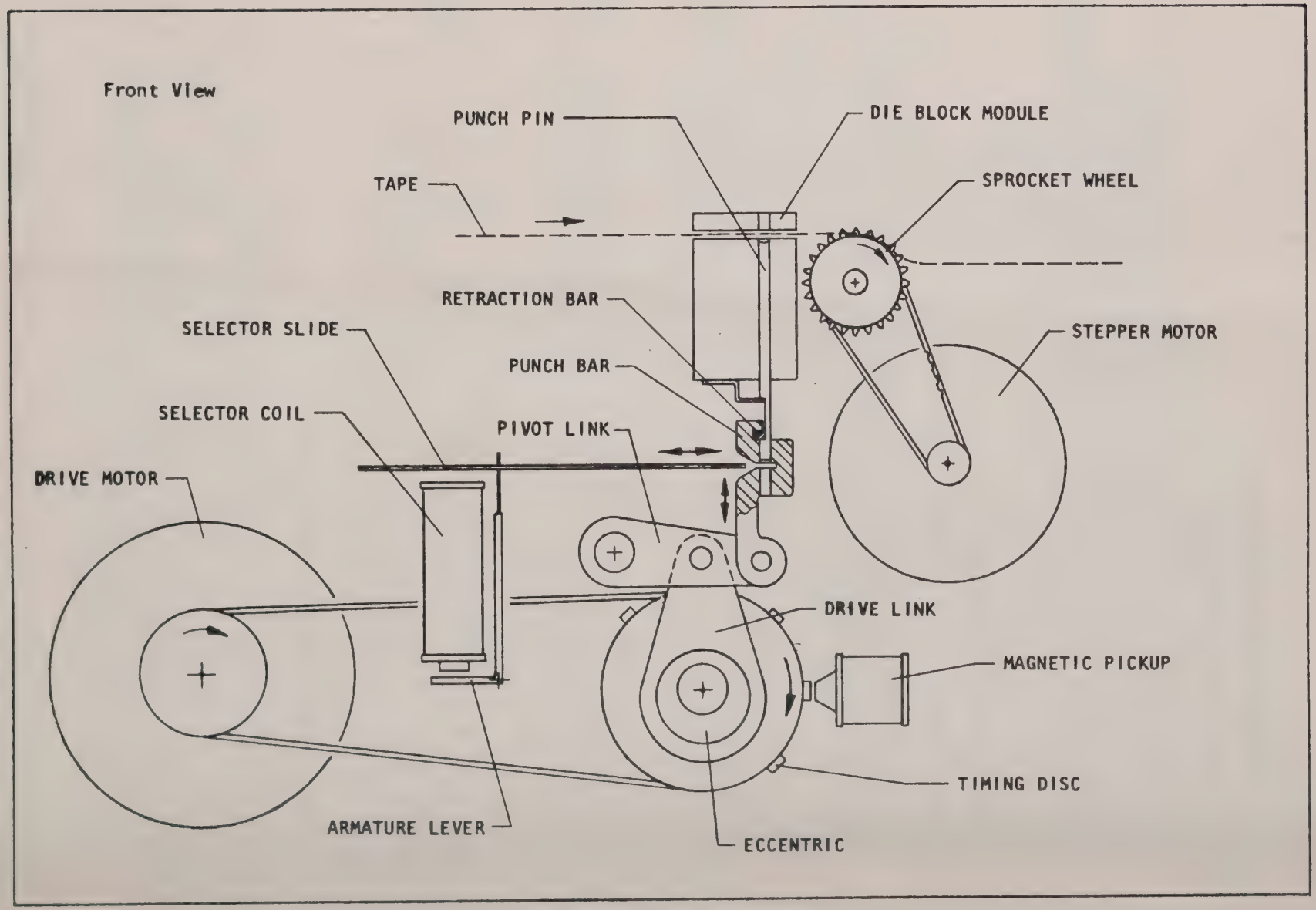
This "Non Return to Zero" operating principle drastically reduces the motion of the selecting slides. For example, if 10 consecutive holes are punched, the slide moves to the right only once, before the first hole, and returns to the left only once, after the tenth hole. It naturally follows that the selecting slide for the feed track gets activated only once for any string of data.

3.2.2 TAPE PUNCHING (see Figure 3-1)

An AC drive motor is used to supply the energy to push the punch pins through the paper and then retract the pins. The rotary motion of the motor is converted to simple harmonic motion by belting the motor to an eccentric crank. Since the punch bar is connected to the crank, it also moves up and down in simple harmonic motion. The motion of the selecting slide is synchronized with the motion of the punch bar by employing a magnetic pick-up which senses the position of the mainshaft with the eccentric crank.

The timing is set so the selecting slide enters the punch bar when the eccentric is at its low point. The punch bar then

FIGURE 3-1 TAPE PERFORATOR MECHANISM



moves upward. This action causes the selecting slide to make contact with the bottom surface of the punch pin. Further motion of the punch bar causes the punch pin to be forced through the paper that is threaded thru the die block assembly. It should be noted that the selecting slide is flexing while this action is taking place.

When the eccentric is at top dead center, the punch pins have completed the upward motion. Further motion of the eccentric causes the retraction bar to engage with the lower corner of the notched section in the punch pin, resulting in positive retraction from the tape. During the down stroke of the punch bar, the selecting slides are removed from their selected position.

The sequences described above cause holes to be punched in the tape. If the selecting slide is not activated, the punch bar motion will not push the selecting slide into the punch pin. Thus, the punch pin will not move, and tape will not be punched.

3.2.3 TAPE ADVANCE (see Figure 3-1)

The feed track in the tape is engaged with a sprocket wheel. The sprocket wheel is belted to a stepping motor. The motor is signaled by the magnetic pick-up to advance the tape when the punch pins leave engagement with the tape.

To backspace, the stepper motor is directed to step in the reverse direction.

4. PREVENTIVE MAINTENANCE

4.1 PREV. MAINTENANCE INTERVAL

Preventive maintenance consists primarily of cleaning and lubricating the perforator mechanism. It should be performed as a regular routine to insure maximum life and reliability.

Paper Tape, any color but black:	12 months, or 250 1000 ft. rolls, whichever comes first.

The environmental operating conditions, as well as the tape material, must be considered before applying the above periods. See Section 2.3 for information on recommended tape materials.

4.2 LUBRICANTS

The widely used Western Electric KS7470 oil and KS7471 grease are suitable for the MODUPERF mechanism. They are available from the following sources:

Part No./Description		Supplier
KS7470	Oil	Western Electric
KS7471	Grease	
88970	Oil (1 qt. can)	Teletype Corp.
88971	Oil (1 gal. can)	Skokie, Illinois
88973	Grease (1 lb. can)	
7668	Oil, Lub. Kit, (4 oz. bottle)	Data Specialties, Inc.
7669	Grease, Lub. Kit. (2 oz. jar)	Northbrook, Illinois

4.3 TOOL LIST

The following tools are required to perform preventive maintenance on the perforator mechanism.

5/16" Nut Driver, outside diameter at socket to be .450" maximum.

Small soft bristle brush, to remove paper lint from mechanism.

4.4 PREVENTIVE MAINTENANCE PROCEDURE

4.4.1 PROCEDURE OUTLINE

The MODUPERF perforator mechanism consists of 3 main modules; main framemodule, die block module, and selector module. To service the unit, the selector module is removed to gain access to some of the lubricating points.

Due to the unique construction of the mechanism, the removal of the selector module is very easy, fast, and requires only the removal of 2 screws. Similarly, the remounting is also easily accomplished and NO ADJUSTMENTS are necessary. The objective of the preventive maintenance procedure is to clean, lubricate, and visually inspect the mechanism.

4.4.2 REMOVAL/REMOUNTING OF SELECTOR MODULE

Removal:

1. Loosen 2 screws (5/16" Hex Head) which hold selector module to main frame, and slide selector module to its maximum left position.

2. Remove 2 screws and selector module from unit.

Remount:

1. Mount selector module to main frame in its maximum left position. Do not tighten the 2 screws.

2. Slowly slide selector module to the right until it gets stopped by pin protruding from die block module.

3. While pressing selector module against pin, tighten 2 screws. Make sure once screws are tightened, the selector module firmly rests against pin.

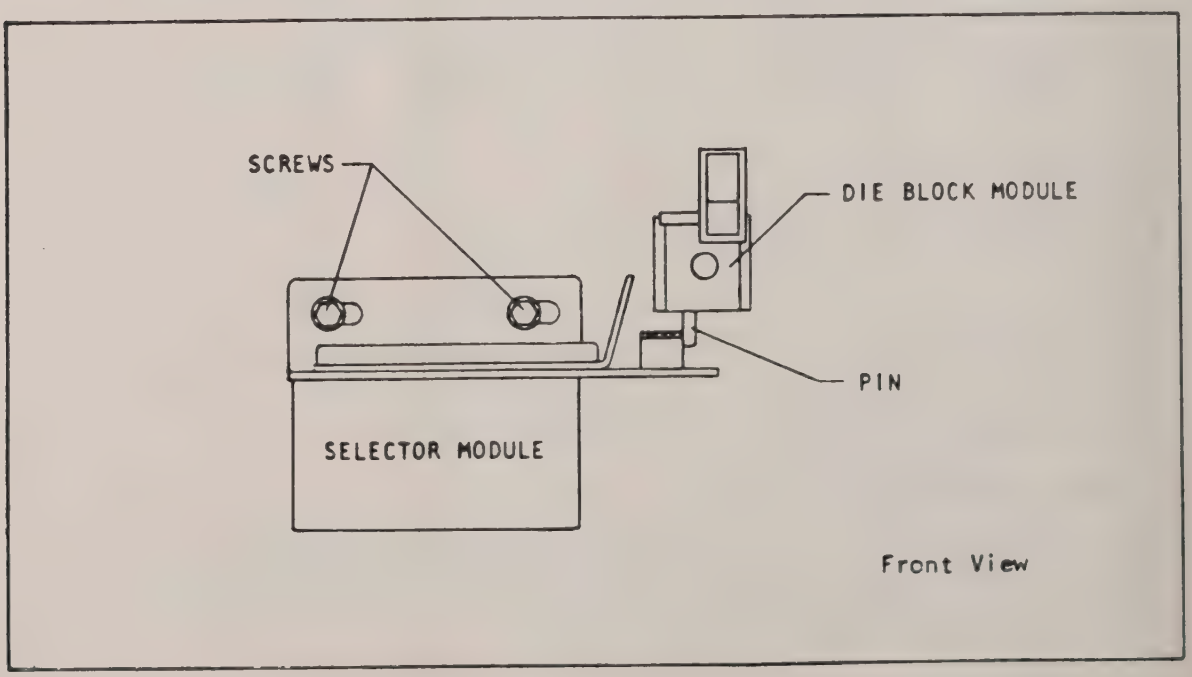


Figure 4-1

4.4.3 PREVENTIVE MAINTENANCE OF SELECTOR MODULE

Remove paper lint and excess grease. Inspect module for damaged or loose parts. DO NOT LUBRICATE any part on selector module.

4.4.4 PREVENTIVE MAINTENANCE OF DIE BLOCK MODULE

Brush off any paper lint around die block entry and exit. Remove lint from punch pins and punch bar which captivates the lower ends of the punch pins.

Lubricate the following points (see Figure 4.2):

1. Die block oil reservoir, - 5 drops of oil into opening in plastic part.

2. Lower ends of punch pins where they are captivated by punch bar - 4 drops of oil total.

3. Felt pad, - oil until felt is saturated.

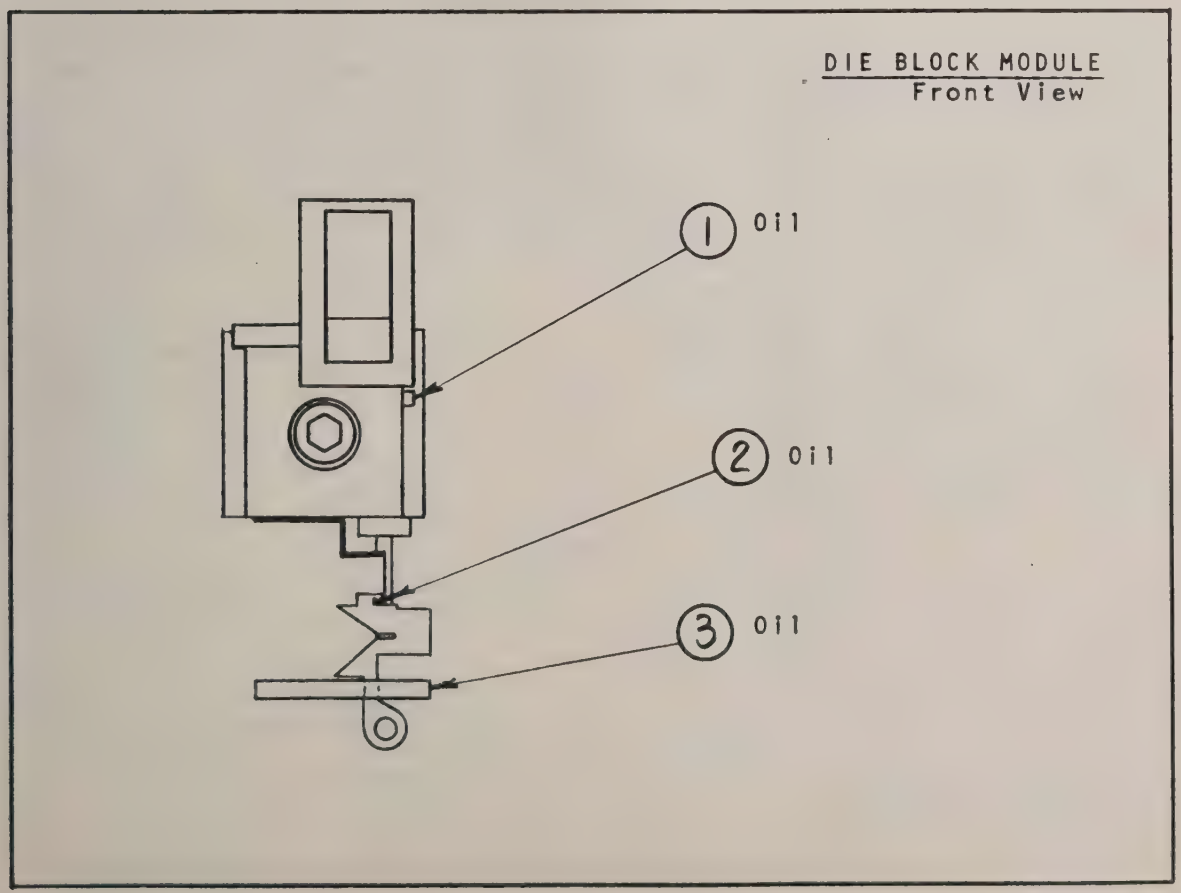


Figure 4-2

4.4.5 PREVENTIVE MAINTENANCE OF MAIN FRAME MODULE

Remove any accumulations of paper lint and/or chad from tape guide area, around feedwheel, from links below die block module, and any other area where lint has accumulated. If necessary, clean off any metallic filings or objects which might have been attracted by the magnetic pick-up.

Inspect frame assembly for worn belts, loose, or damaged parts.

Lubricate the following points (see Figure 4.3):

1. Drive motor, 2 oil holes, - 6 drops per hole.
2. Pivot link post below die block module, - 2 drops on each end of link.
3. 5 pivot points and felt washers, - 2 drops per pivot point, oil felt washers until saturation.
4. Belt tension arm bearing, - 1 drop of oil each end of bearing.
5. Belt tension roller bearing, - 1 drop of oil.

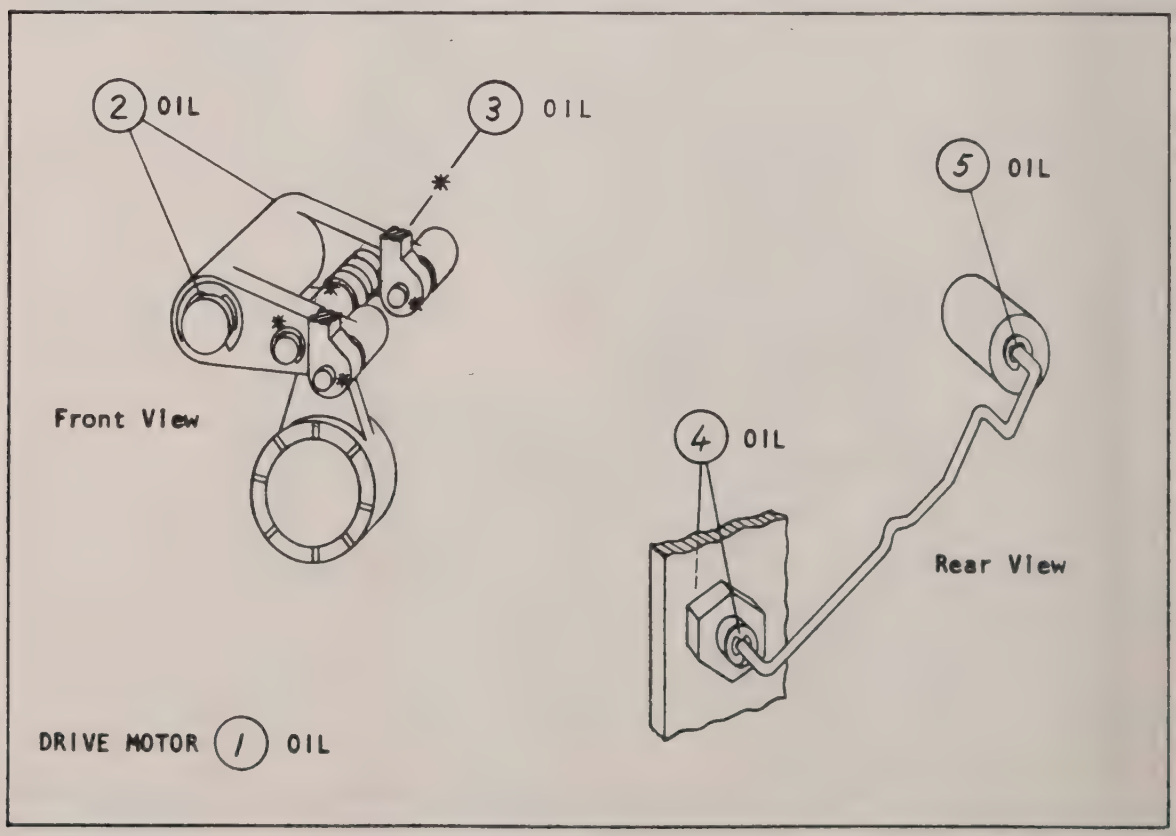


Figure 4-3

5. CORRECTIVE MAINTENANCE

5.1 GENERAL

The MODUPERF perforator mechanism is a precision instrument, carefully factory adjusted and tested. Unnecessary maintenance or attempt to improve performance must be avoided. Any adjustments found necessary should only be carried out by trained personnel equipped with the correct tools, otherwise proper operation will not be obtained.

Certain repairs and adjustments are beyond the scope of service personnel, and are, therefore, not described in this manual

CAUTION

Definitely NO attempt must be made to adjust the areas/modules listed below. Return to factory for replacement.

1. Selector module, - complete unit.

2. Die block module, except tape guide (Section 5.4.6).

3. Position of mainshaft housing and pivot link post,- these parts control the location of the punch stroke (see Figure 3-1).

5.2 SEQUENCE OF ADJUSTMENTS

The sequence in which the adjustments appear should be followed when a complete readjustment of the perforator mechanism is undertaken. Since some adjustments are interrelated, making an adjustment in one area might require rechecking in other related areas. Instructions to that effect are given at the beginning of each section. In some adjustment procedures several requirements (A, B, & C) have to be met. They should be done in the given sequence.

5.3 TOOL LIST

The following are required to perform corrective maintenance.

Screw drivers; 1/32 x 1/4" blade, No. 1 and No. 2 Phillip Type.

Nut drivers; 3/16" and 11/32 hex. 5/16" hex with socket O.D. of .450" maximum.

"Allen" Head wrenches; .050", .062", 1/8", and 3/16".

6" Calipers.

Thickness Gages; .003", .005", .010", .012" and .030".

Force Gage; 280 gram (10 oz.) maximum.

5.4 DETAILED ADJUSTMENTS

5.4.1 MAGNETIC PICK-UP GAP

Interrelated affected adjustment: 5.4.2 Timing Disc Location.

Requirement A: Magnet to be positioned so that mark on magnet is nearest main panel.

Requirement B: Gap between face of magnetic pick-up and any tooth of timing disc to between .003" and .012"

To adjust:

A) Remove 3 screws, mount magnet as required.

B) Loosen 3 screws, slide pick-up in desired direction to meet requirement. Tighten screws. Re-check gap on all teeth.

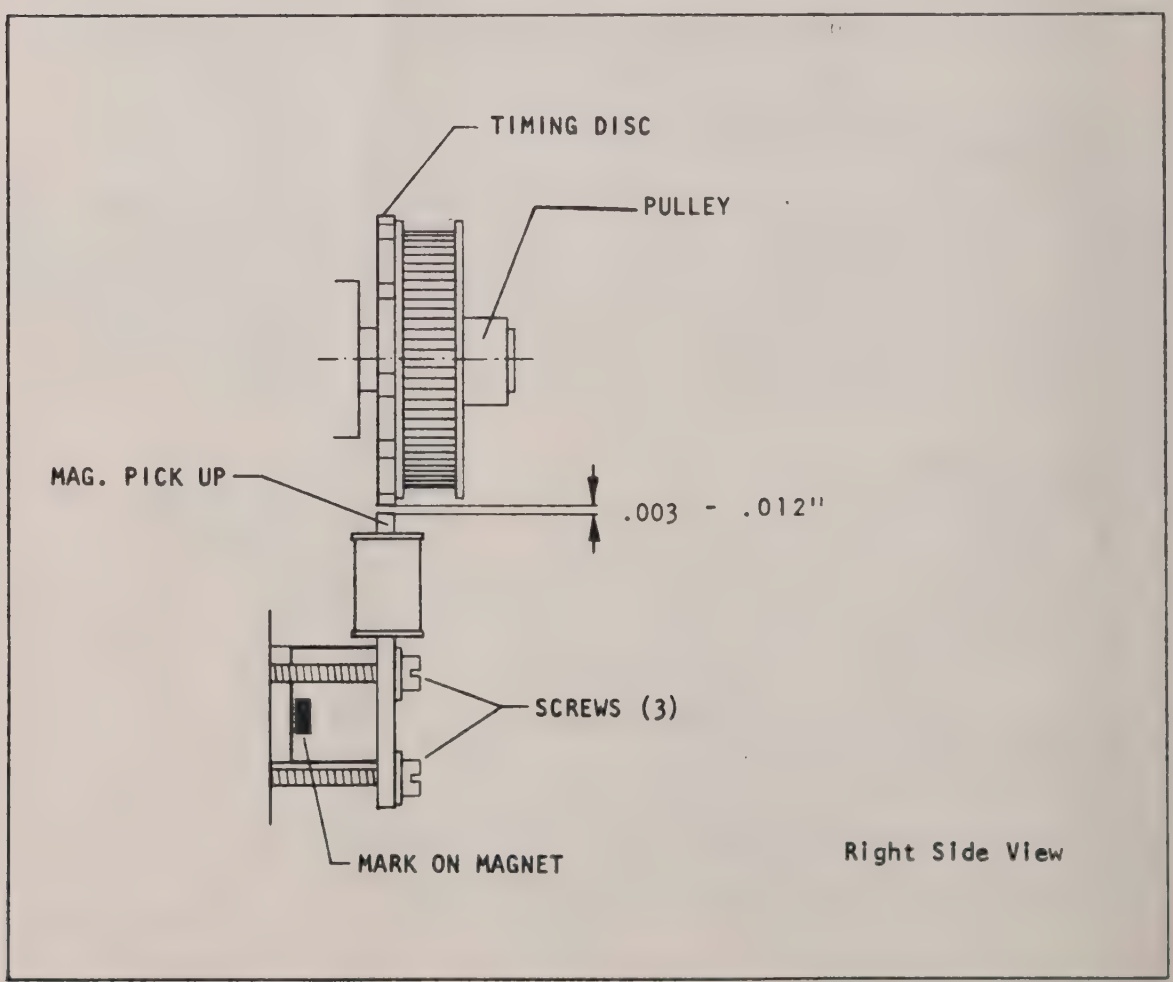


Figure 5-1

5.4.2 TIMING DISC LOCATION

Requirement A: Timing disc to line up with magnetic pick-up plate within .020", as gauged by eye.

To adjust: A: Loosen 2 set screws, move timing disc assembly in desired direction to meet requirement. Tighten screws. Re-check requirement.

Requirement B: With tooth No. 2 lined up with magnetic pick-up, slot in end of main shaft to point to 3 o'clock notch within ± 3°, as gauged by eye.

To adjust B: Loosen 2 set screws in pulley hub and rotate timing disc so No. 2 tooth lines up with magnetic pick-up. While holding timing disc in this position, rotate mainshaft (screwdriver in slot) so slot end with angled surface lines up with 3 o'clock notch in drive link. Tighten screws. Re-check requirements A and B.

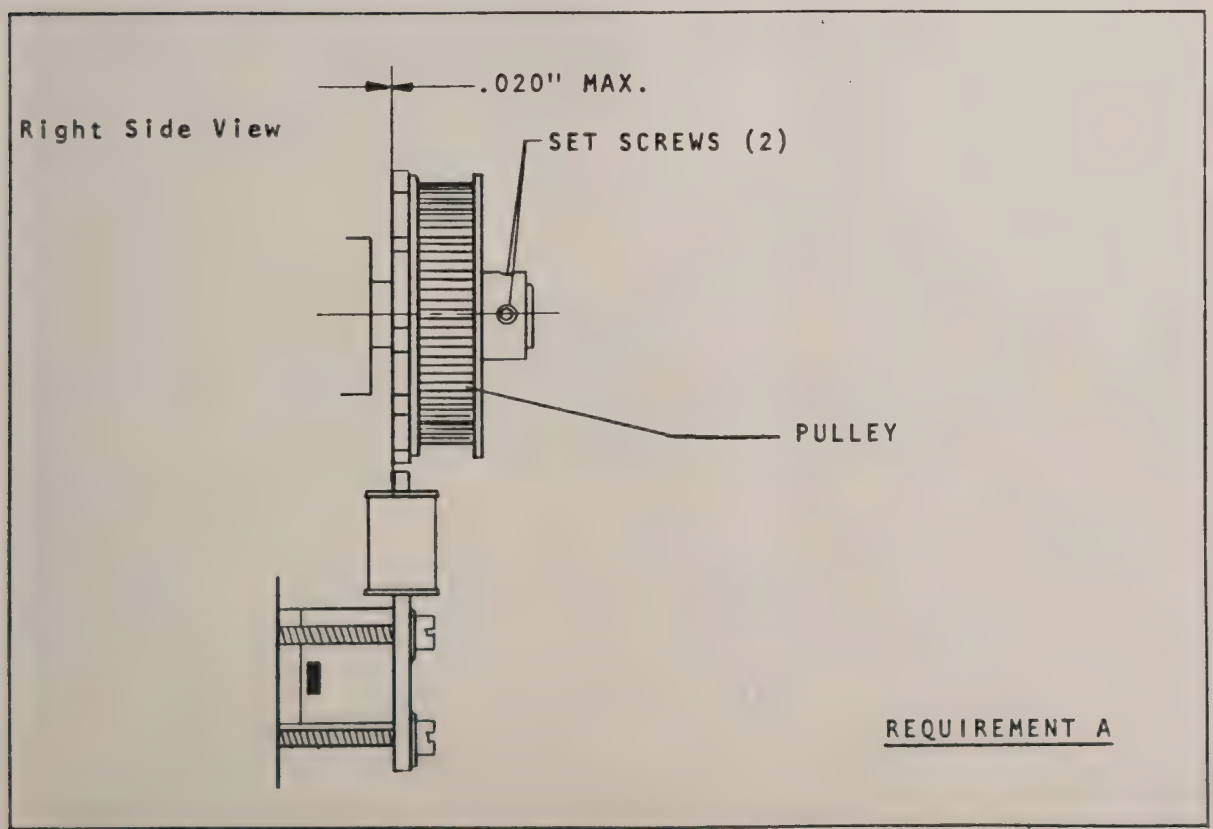


Figure 5-2

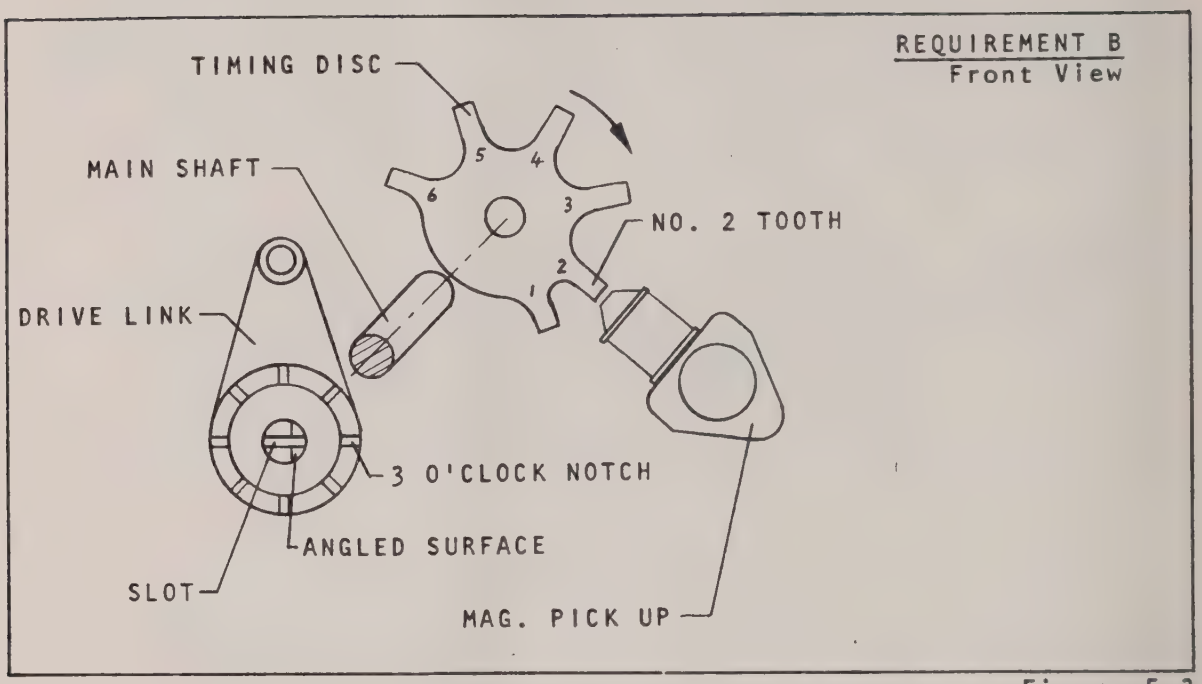

REQUIREMENT B
Front View
TIMING DISC
MAIN SHAFT
DRIVE LINK
NO. 2 TOOTH
3 O'CLOCK NOTCH
ANGLED SURFACE
SLOT
MAG. PICK UP
1
2
3
4
5
6

Figure 5-3

5.4.3 SPROCKET DRIVE ASSEMBLY

Interrelated affected adjustments: 5.4.4 Feed Sprocket Position
5.4.5 Tape Lid Gap
5.4.9 Character Spacing

The sprocket drive assembly is defined as the bearing housing, shaft, and pulley assembly which drives the feed sprocket. It is located on the immediate right of the die block module. For clarity, Figure 5-4 illustrates the sprocket drive assembly with sprocket and right top plate assembly removed.

Requirement A: Force needed to rotate pulley not to exceed 140 g (5 oz). Measure force as illustrated with BELT DISENGAGED from pulley.

Requirement B: Axial play between shaft and bearing housing not to exceed .002".

To adjust: A & B: Remove right top plate assembly (2 screws on rear of main panel) and feed sprocket (1 set screw). Loosen set screw in collar, move collar to meet requirement A and B. Tighten screw, re-check requirements.

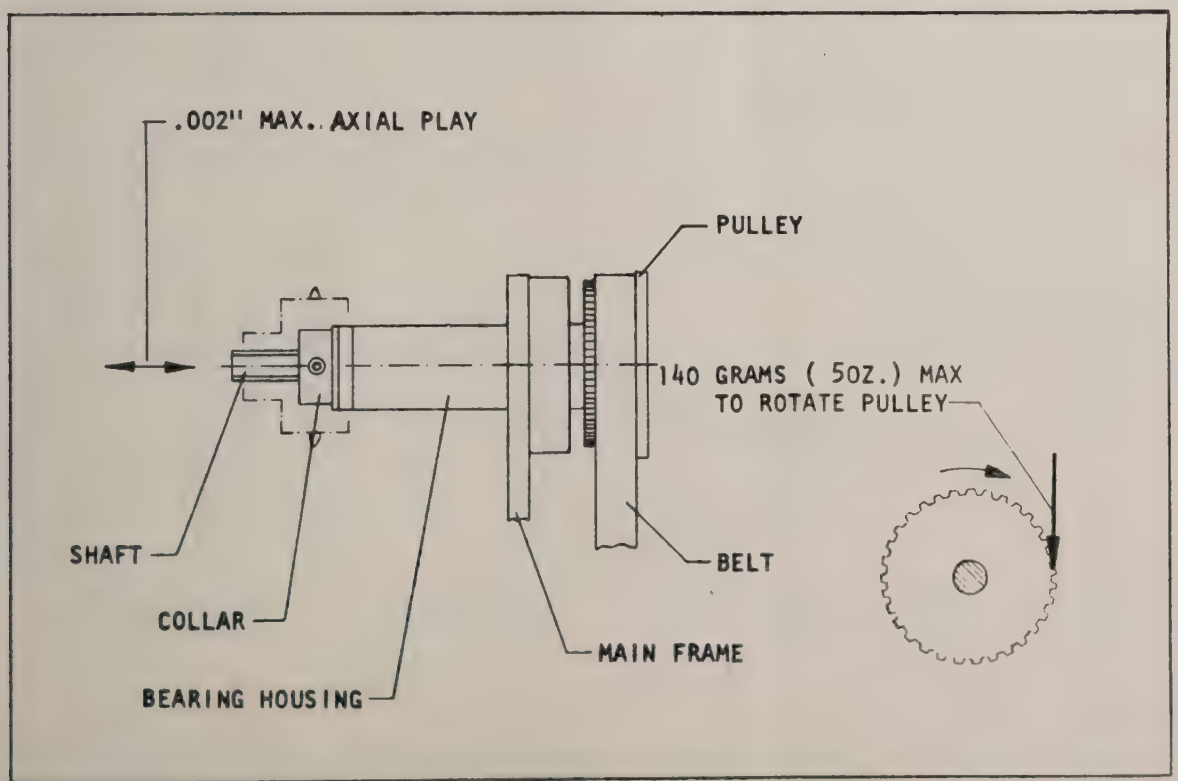


Figure 5-4

5.4.4 FEED SPROCKET POSITION

Interrelated affected adjustments: 5.4.5 Tape Lid Gap
5.4.9 Character Spacing

Requirement: Distance between front surface of main frame and center of sprocket teeth to be 1.100 ± .002".

To adjust: Remove right top plate assembly (2 screws on rear of main panel). Loosen set screw, move sprocket in desired direction, tighten set screw, re-check requirement.

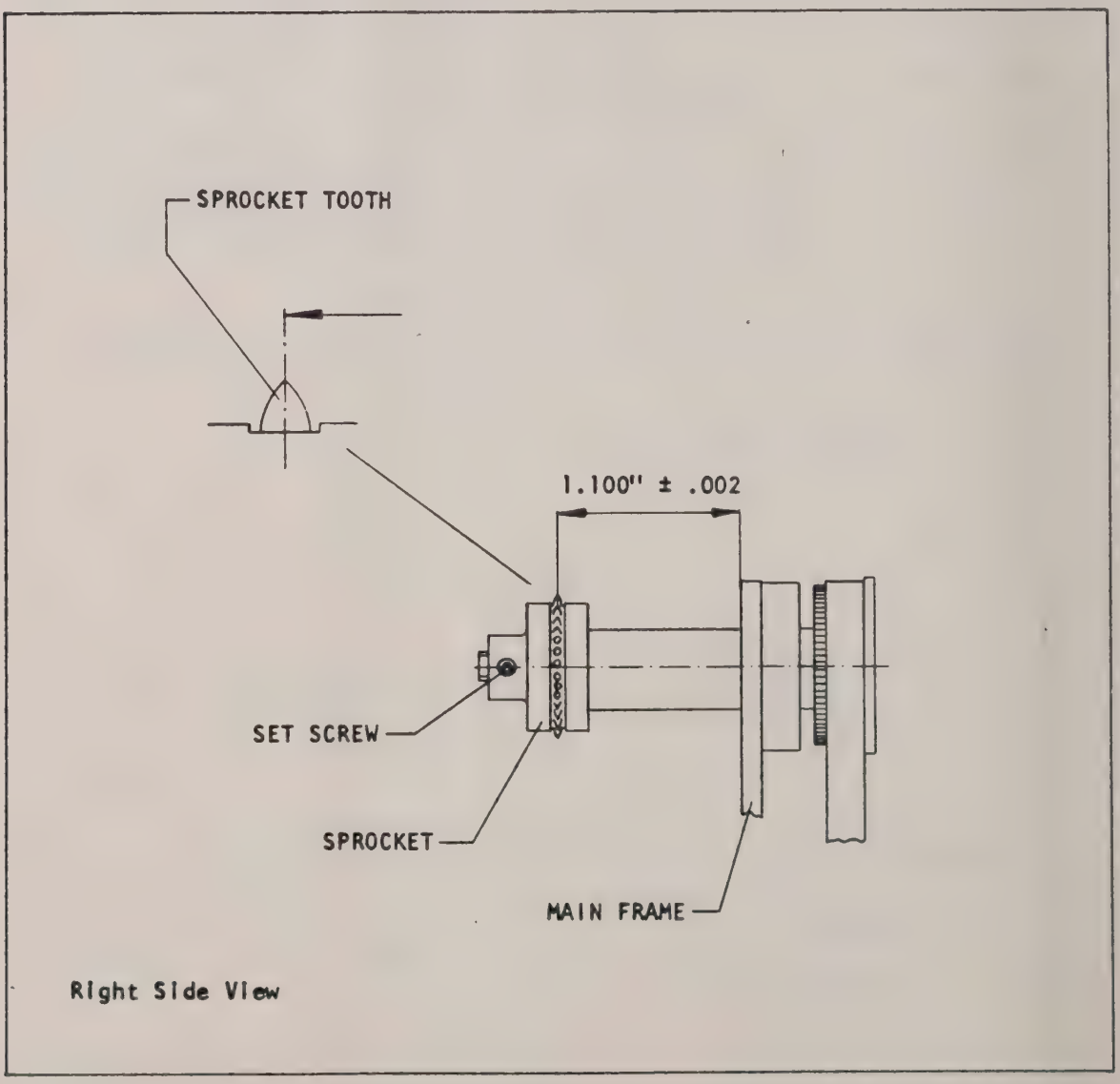


Figure 5-5

5.4.5 TAPE LID GAP

Interrelated affected adjustments: 5.4.9 Character Spacing.

Requirement: Gap between sprocket wheel and tape lid to be .005-.012". This applies to a 30° segment only, as illustrated. Outside this segment, gap to be .005" minimum. Gap between tape lid and top plate to be .010"-.030".

To adjust: Turn two adjusting screws to increase or decrease gap to meet requirement.

Note: Line up tape lid sideways so slot is centered with sprocket teeth, as gauged by eye.

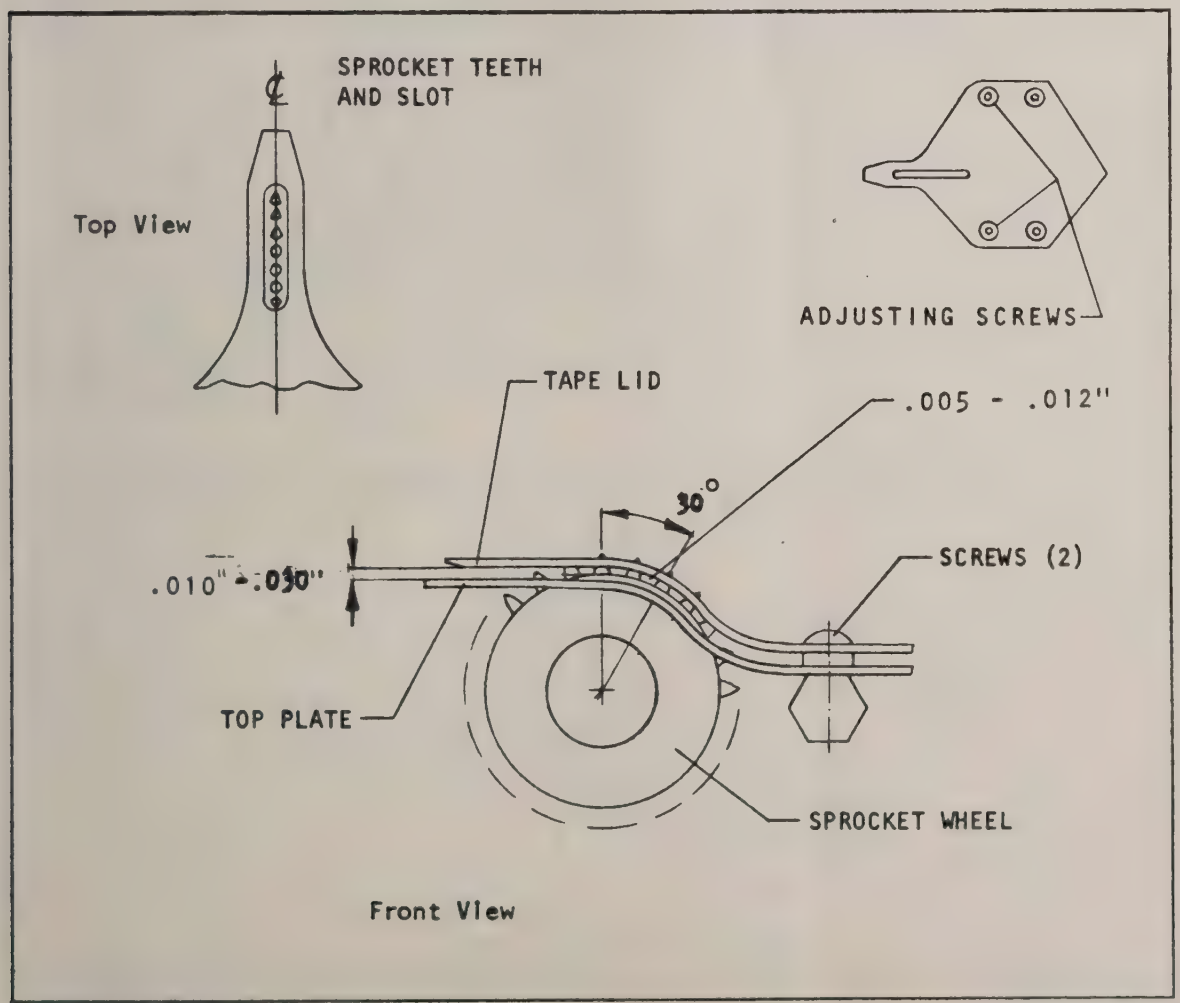


Figure 5-6

5.4.6 TAPE GUIDE

The tape guide is part of the die block module and is located left of the chad chute. A MODUPERF might be set up to punch 4 different tape configurations by changing tape guides and/or die blocks. Each tape guide has an identification number.

Requirement: Centerline of feed hole to edge of tape dimension (Dimension X, see Figure 5-7)

TAPE	GUIDE ID	X DIM.
8 Level, In Line	8	.392 ± .004"
5 Level, In Line	5	.296 ± .004"
6 Level, In Line	6,7	.392 ± .004"
6 Level, Advanced	6A	.441 ± .004"

To adjust: Loosen 2 screws which hold tape guide to die block. Insert one thickness of paper tape (.004" thick) between tape guide and frame plate. Slide guide against frame plate and tighten 2 screws. Re-check requirement. If X dimension is out of range, adjust guide with no tape or 2 thicknesses of tape.

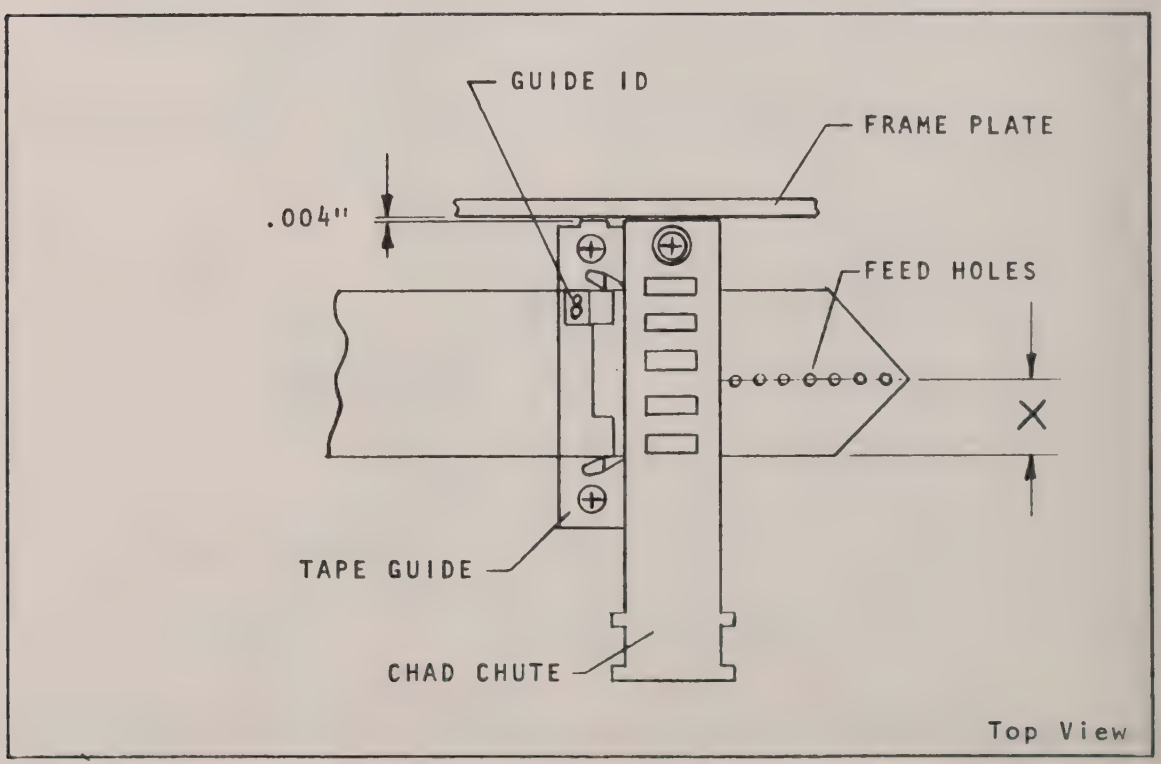


Figure 5-7

5.4.7 BELT TENSION - STEPPER MOTOR

Interrelated affected adjustments: 5.4.9 Character Spacing

Requirement: Adjust spacing between two legs of belt as illustrated. Roller force as illustrated in Figure 5-8.

To adjust: Loosen screws which hold motor mounting plate to main frame. Move motor up or down to meet belt tension requirement. Tighten screws, re-check requirement. Adjust length of spring to meet force requirement.

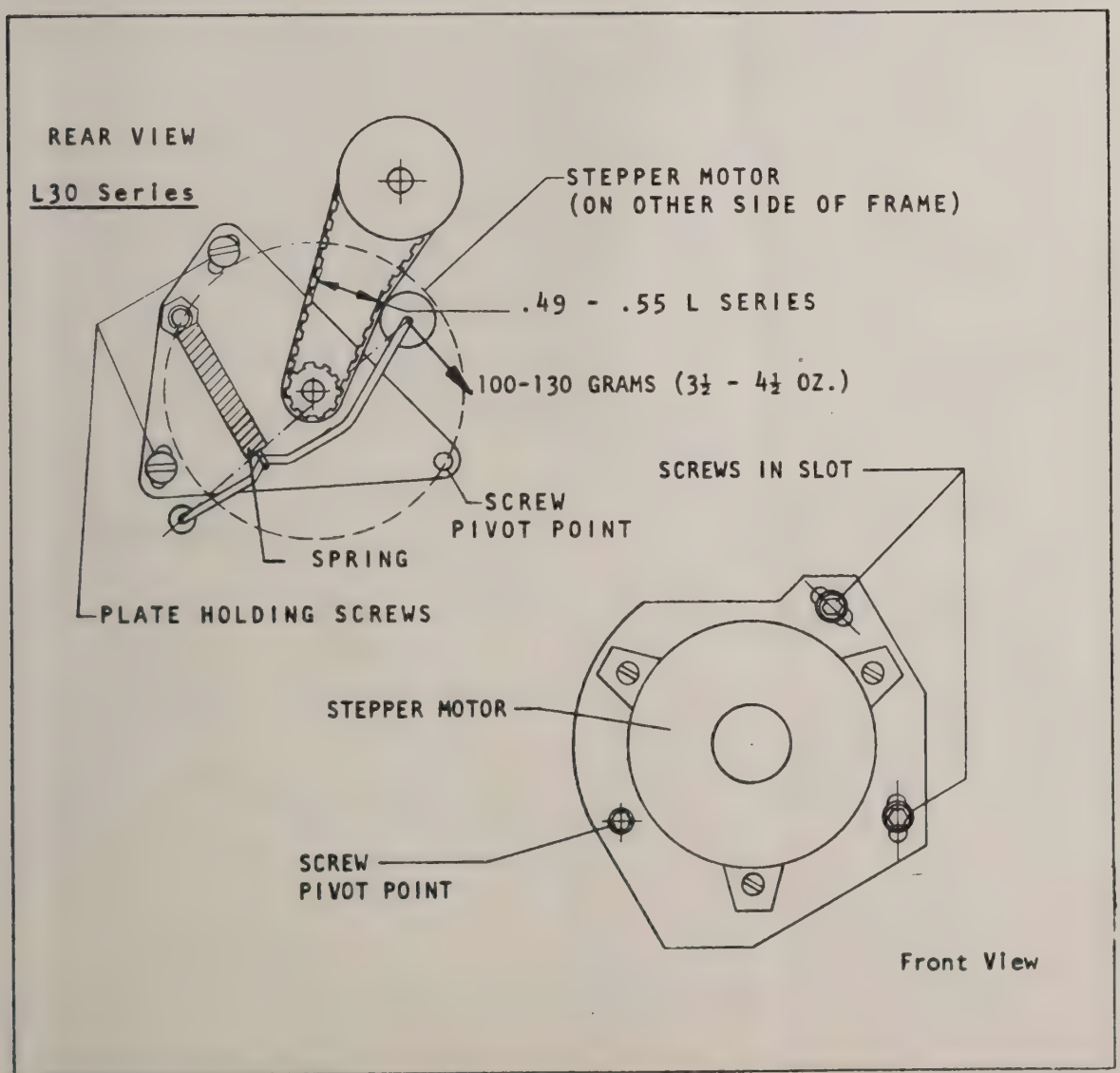


Figure 5-8

5.4.8 BELT TENSION - DRIVE MOTOR

Requirement: Timing belt to deflect specified amount with 110g (approximately 4 oz.) force applied in illustrated direction.

To adjust: Loosen motor mounting nuts and/or screws and slide drive motor left or right to meet tension requirement. DO NOT over tighten fasteners, see maximum values in figure 5-9.

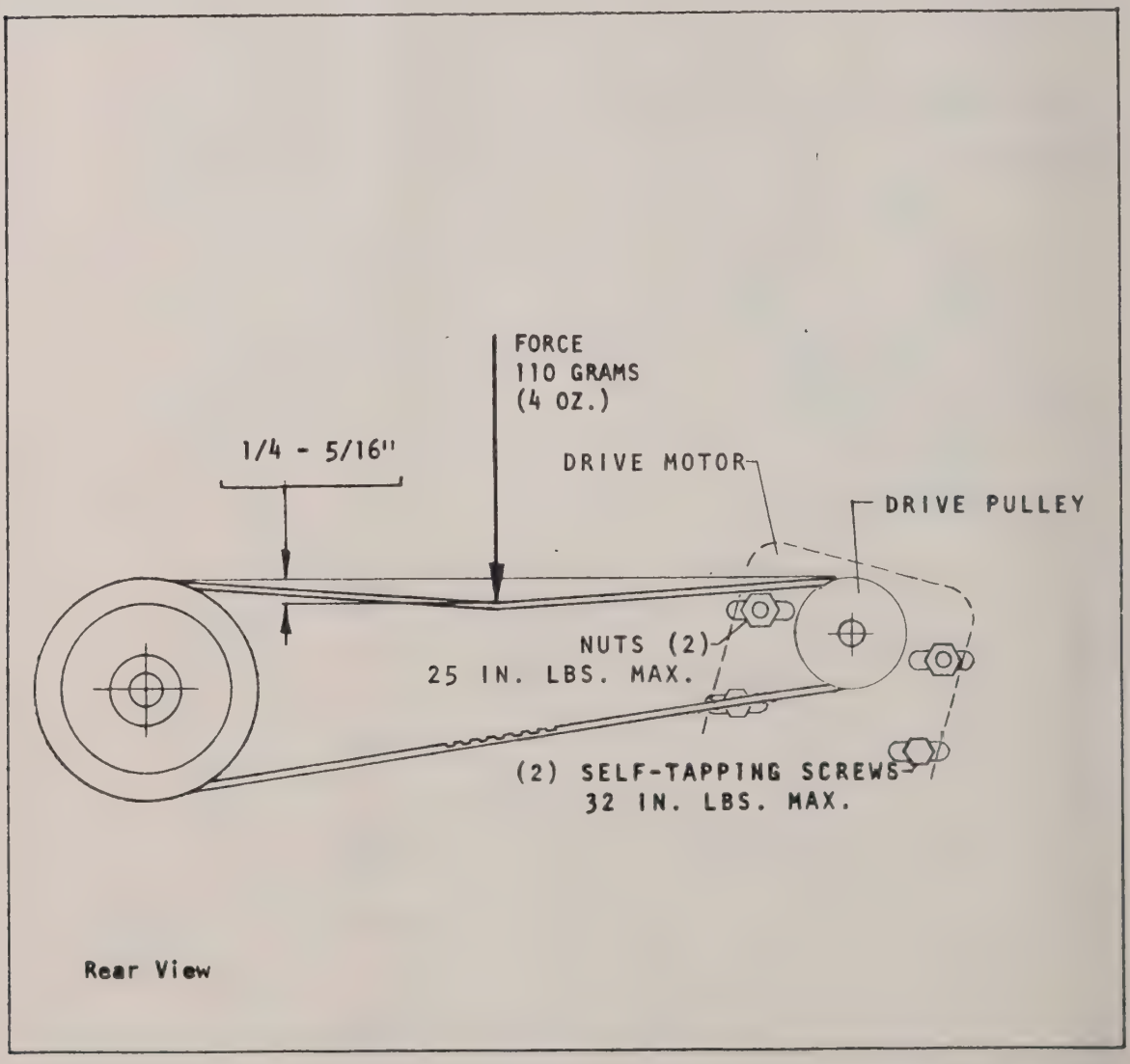


Figure 5-9

5.4.9 CHARACTER SPACING

Perforate a length of tape with a typical code arrangement. Place a feed hole over the zero line of an exact scale (scale of calipers, for example), with .1" graduations and observe the positions of the feed holes in relation to the .1" graduations.

Requirement: Cumulative spacing error in 5 inches to be a maximum of ±.025 inches.

To adjust:

Loosen motor mounting screws just enough so stepper motor can be rotated manually. Rotate clockwise for longer, counter clockwise for shorter spacing. When requirement is met, tighten screws, re-check spacing.

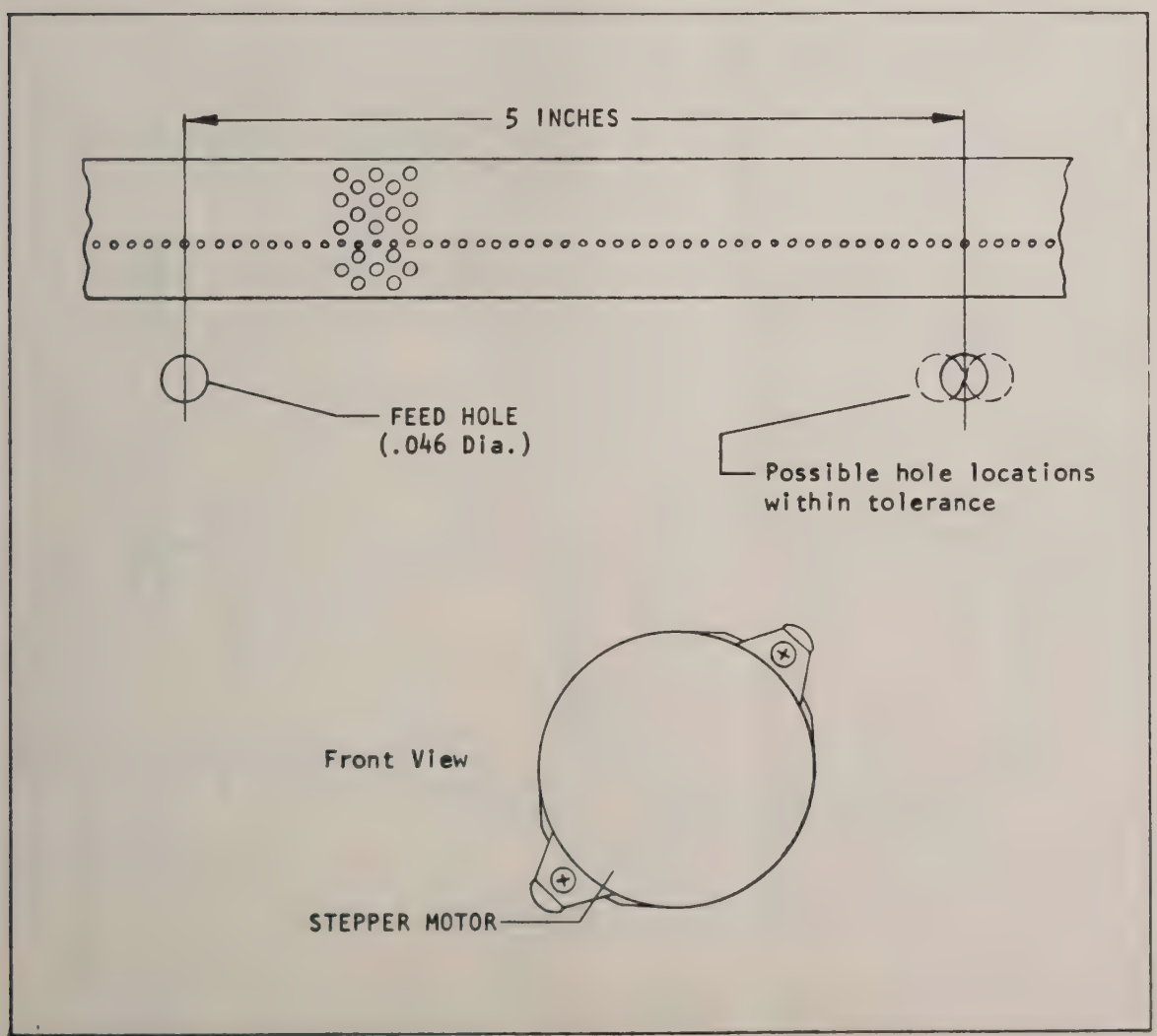


Figure 5-10

5.5 TAPE SUPPLY REQUIREMENT

In order to achieve optimum performance of the MODUPERF mechanism, 3 oz. maximum back tension on the tape is recommended. To achieve this, the tape supply configuration has to isolate the inertia of the tape roll from the perforator. Any start/stop condition will apply a back tension of 3 oz. maximum to the tape.

While there are many ways to achieve this, the concept illustrated in Figure 5-11 has been very successful.

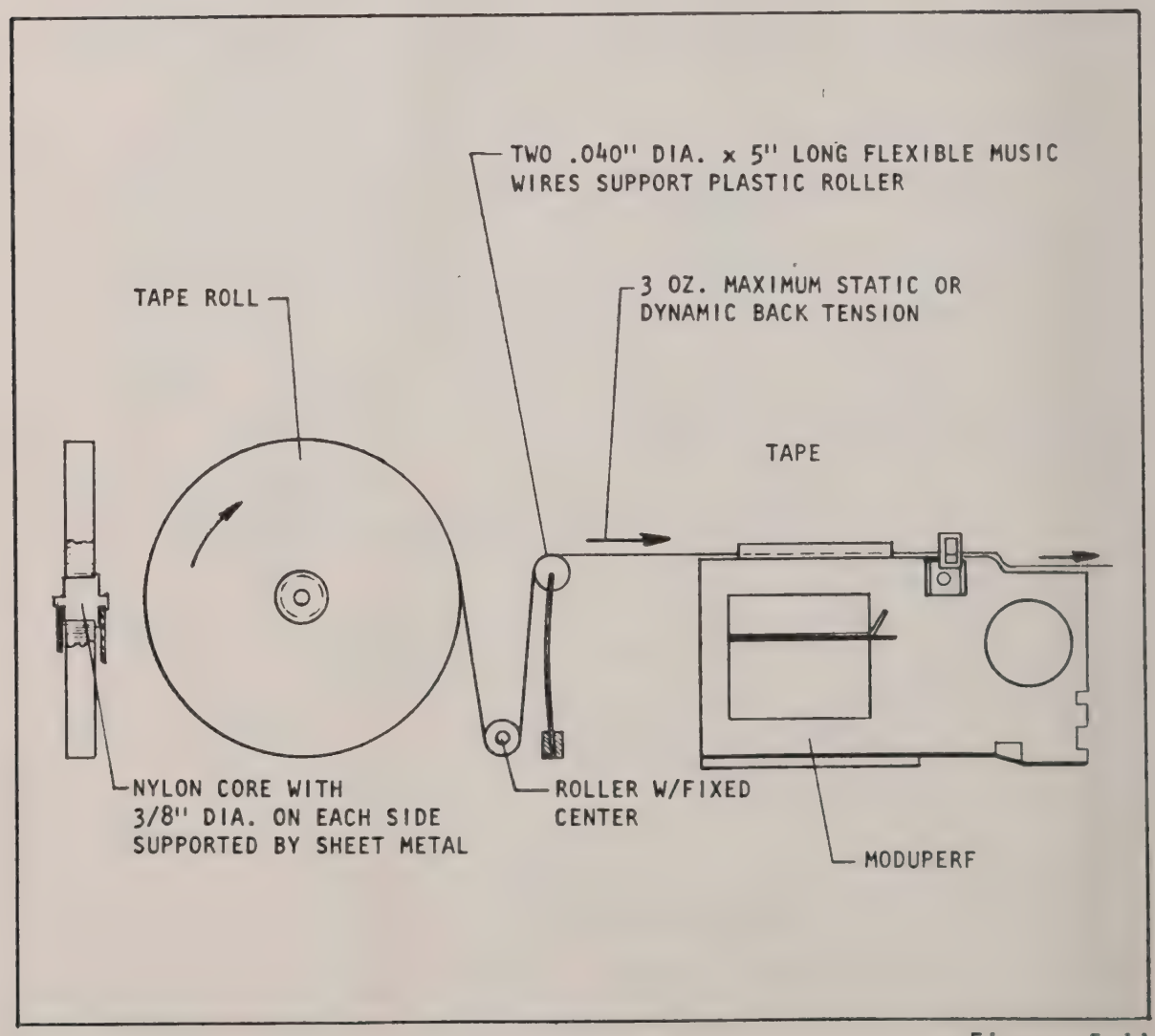

TWO .040" DIA. x 5" LONG FLEXIBLE MUSIC WIRES SUPPORT PLASTIC ROLLER
TAPE ROLL
3 OZ. MAXIMUM STATIC OR DYNAMIC BACK TENSION
TAPE
NYLON CORE WITH 3/8" DIA. ON EACH SIDE SUPPORTED BY SHEET METAL
ROLLER W/FIXED CENTER
MODUPERF

Figure 5-11

6. FAULT ANALYSIS

6.1 GENERAL

Most difficulties encountered with electro-mechanical equipment result from poor data or control inputs, misinterpretation of equipment specifications, or incorrect operator control.

Before attempting to troubleshoot the equipment, the technician should read and understand the operation and interface descriptions. The interface requirements are described in the MODUPERF Interface manual or in the System Maintenance Manual if the perforator mechanism is part of a system.

TABLE 6-1

ITEM NO.	FAULT	PROBABLE CAUSE	EXAMINE/REMEDY
1	Drive motor does not start.	a) False connections of motor leads.	a) Check connections of 115V motor (black leads) or 230V motor (red leads)
		b) Belt too tight.	b) Belt tension adjustment, - section 5.4.8.

TABLE 6-1 (continued)

ITEM NO.	FAULT	PROBABLE CAUSE	EXAMINE/REMEDY
1 (cont)	Drive motor does not start.	c) Motor temperature too high, thermal overload protection has been actuated.	c) See item 2 a
		d) Open/Shorted motor winding.	d) DC winding resistance at 25° C; 115V motor: 5.2-6.0 Ohms 230V motor: 32-36 Ohms If motor is replaced, perform belt tension adjustment (5.4.8).
2	Drive motor rotates but stops after short period of operation.	a) Motor temperature too high, thermal overload protection has been actuated.	a) Verify that motor is connected to correct voltage. ie - 230V NOT connected to 115V winding. aa) Verify that no binding exists, motor turns mechanism freely. aaa) Examine ventilation conditions.

TABLE 6-1 (continued)

ITEM NO.	FAULT	PROBABLE CAUSE	EXAMINE/REMEDY
3	Drive motor tries unsuccessfully to come up to speed.	a) Holes are punched before motor has come up to full speed (full power).	a) Examine time delay between motor turn-on and first punch command (code selection); it should be 1.6 seconds minimum.
4	Unable to thread tape thru die block.	a) Die block slot obstructed by paper shreds.	a) Clean slot in die block, use thin piece of metal (thickness gage).
5	Tape does not advance.	a) Magnetic pick-up pulse missing.	a) See item 9.
		b) Faulty stepper motor operation.	b) See item 8.
6	Character spacing is off, but uniform.	a) Faulty spacing adjustment.	a) Perform character spacing adjustment (5.4.9).
7	Erratic character spacing.	a) Excessive back tension on tape.	a) Verify that static and dynamic back tension from unwinding equipment does not exceed 85 grams (3 oz.). Inertia of supply roll has to be decoupled from perforator. (5.5)
		b) Faulty stepper motor operation.	b) Remove tape from unit and observe motion of sprocket wheel. If erratic see item 8.

TABLE 6-1 (continued)

ITEM NO.	FAULT	PROBABLE CAUSE	EXAMINE/REMEDY
7 cont.	Erratic character spacing.	c)Tape is punched with stepper motor not settled.	c)Verify timing disc location (5.4.2).
		d)Worn sprocket drive belt.	d)Replace belt. Perform belt tension adjustment (5.4.7).
		e)Faulty drive belt tension.	e)Perform belt tension adjustment (5.4.7).
		f)Faulty tape lid gap.	f)Perform tape lid gap adjustment (5.4.5).
8	Faulty stepper motor operation.	a)No DC power/ faulty switching sequence.	a)Verify DC power is available on motor connector and switched in correct sequence.
		b)Bind in sprocket drive assembly.	b)Verify sprocket drive assembly adjustment (5.4.3).
		c)Defective motor windings.	c) Check winding resistance of each of 4 phases. At 25°C: 4.5 to 5.5 Ohms If motor is replaced, perform character spacing adjustment (5.4.9)
		d)Faulty timing of 2nd, 3rd, 4th step	d) Verify timing of stepper motor pulses as listed in MODUPERF Interface Manual or System Manual where this mechanism is used.

TABLE 6-1 (continued)

ITEM NO.	FAULT	PROBABLE CAUSE	EXAMINE/REMEDY
9	Magnetic pick-up pulse missing.	a) Pick-up gap too large.	a) Perform pick-up gap adjustment (5.4.1).
		b) Defective pick-up coil.	b) Verify winding resistance 850-1080 Ohms at 25° C. If pick-up is replaced, perform pick-up gap adjustment (5.4.1).
10	Code/feed holes missing or added.	a) Faulty timing of selector coils.	a) Verify timing and voltage to selector module. If faulty, verify that all pick-up pulses per revolution/cycle are fed to the electronic. If pulses are missing, perform pick-up gap adjustment (5.4.1). aa) Verify timing disc location adjustment (5.4.2). aaa) Verify orientation of permanent magnet, see figure 5-1 section 5.4.1.
		b) Faulty engagement of selector module.	b) Verify that selector module rests firmly against pin of die block module, if not, see "Remounting of Selector Module", section 4.4.2.
		c) Data input outpaces mechanism speed, or, excessive mechanism speed.	c) Verify that correct drive motor pulley is used, see section 7.2.

TABLE 6-1 (continued)

ITEM NO.	FAULT	PROBABLE CAUSE	EXAMINE/REMEDY
10 cont.	Code/feed holes missing or added.	d) Defective selector module.	d) Replace selector module,--return to factory.
11	Partially punched holes.	a) Die block flexes when punch force is applied.	a) Tighten 1/4"-28 socket head screw which holds die block to main frame.
		b) See item 10	b) See item 10
		c) Faulty punch stroke location.	c) Return unit to factory.
12	Damaged feed holes. (burred, deformed)	a) Excessive back tension on tape.	a) See item 7.
		b) Faulty spacing adjustments.	b) Perform character spacing adjustment (5.4.9).
		c) Tape is advanced too soon (Pins are still in tape).	c) Verify timing disc location adjustment (5.4.2).
		d) Faulty tape lid gap.	d) Perform gap adjustment (5.4.5).

TABLE 6-1 (continued)

ITEM NO.	FAULT	PROBABLE CAUSE	EXAMINE/REMEDY
13	Torn feedholes/code hole	a) Excessive pressure in chad chamber.	a) Verify that chad chute, funnel, tube, etc., are free of obstructions.
		b) Defective or worn die block/punch pins.	b) Replace die block module.
14	Hole slugs (chad) exit thru tape slot.	See item 13	See item 13
15	Feed hole location in relation to tape edge varies.	a) Faulty tape guide setting.	a) Perform tape guide adjustment (5.4.6)
		b) Tape width out of specification.	b) Verify that tape width meets the following standard: 8 Level - 1.000 ± .003" 5 Level - .686 ± .003" 6 Level - .875 ± .003"
		c) Sprocket wheel misalignment.	c) Adjust position of sprocket as per 5.4.4.
		d) Excessive axial play of sprocket wheel.	d) Perform sprocket drive assembly adjustment (5.4.3, Requirement B).
16	Hole quality not acceptable.	a) Defective or worn die block/punch pins.	a) Replace die block module.

7. FIELD MODIFICATIONS

7.1 GENERAL

The modular design of the MODUPERF perforator mechanism allows for easy change of selector module, die block module, operating speed, etc. No additional tools, other than listed in section 5.3, are necessary for field modifications.

7.2 TAPE GUIDE SETTING CHANGE

Figure 7-1 illustrates the tape guide settings for different tape widths. The guide brackets left of the die block are positioned in the appropriate slots. The tape guide on the die block can be mounted upside down for a different tape configuration. (Note; to flip tape guide, the die block has to be removed.) Two tape guides can be used four ways: one guide accepts 8 and 5 level tape, the other accepts 6 level in line and 6 level advanced tape.

7.3 DIE BLOCK CHANGE

Die blocks may be changed as per instructions given in this section. NO adjustments are necessary if it is a replacement block (same tape width and feed hole position).

When there is a change in tape width and/or feed hole location (in-line or advanced) one or both of the following is necessary:

1. Setting of tape guides, see Figure 7-1.

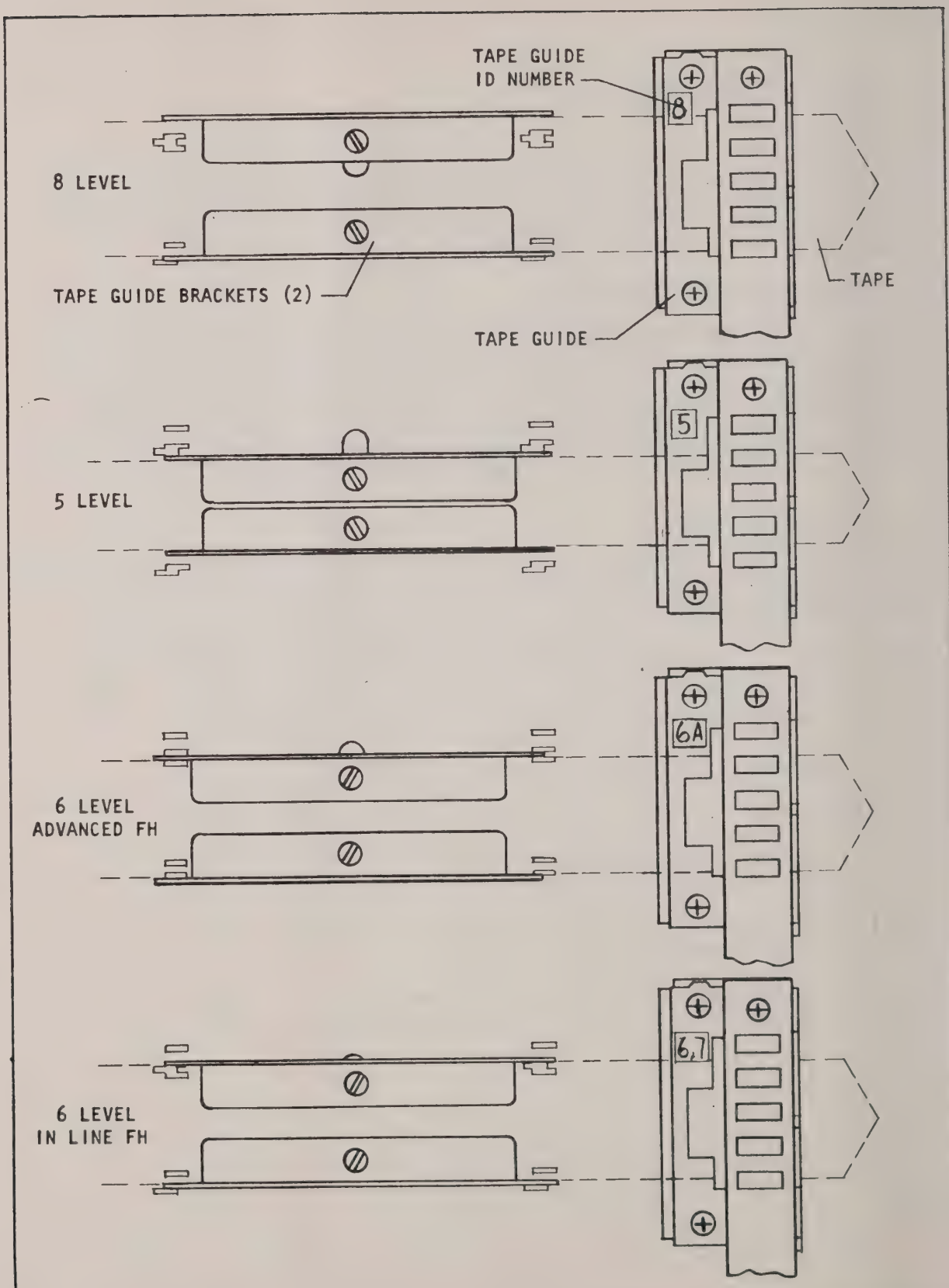
2. Character spacing adjustment 5.4.9.

For REMOVAL of the die block module, follow this sequence:

1. Loosen 2 screws which hold selector module to main frame and slide selector module to its maximum left position.

2. Turn mainshaft so eccentric and punch bar are in their lowest position.

3. Remove socket head screw which holds die block to main frame.



TAPE GUIDE SETTINGS

Figure 7-1

4. Slide die block towards you (frontwards) approximately 1/4" until punch bar is disengaged with pins in pivot link.

5. Lift up punch bar so it clears pivot link and continue to slide die block module frontwards until it clears the main frame assembly.

For REMOUNTING of the die block module, follow this sequence:

1. Make sure mating mounting surfaces of frame and die block are clean.

2. Make sure selector module is in its maximum left position.

3. Turn mainshaft so eccentric and pivot link are in their lowest position.

4. Slide die block module between 2 top plates. Plates will engage with slots in die block.

5. Lift up punch bar so it clears pivot link; continue to slide die block towards main frame. After clearing pivot link, lower punch bar so it engages pins in pivot link while sliding die block against the frame.

6. Secure die block against frame with socket head screw. Make sure screw is torqued down VERY TIGHT.

7. Slowly slide selector module to the right until it gets stopped by pin protruding from die block module.

8. While pressing selector module against pin, tighten 2 screws. Make sure once screws are tightened, the selector module firmly rests against pin.

7.4 SELECTOR MODULE CHANGE

No adjustments are necessary when remounting a selector module. See section 4.4.2 for removal/remounting procedure.

PART 3

MAINTENANCE MANUAL

PART III

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1. FOREWORD

1.1 DESCRIPTION

The 901-1951 Reader Punch Combo is a versatile table top paper tape unit which provides the capability of paper tape handling for KSR teletypes and CRT terminals. Operation may be either Half or Full Duplex while interfacing is accomplished via RS-232 connections. A further description of the 901-1951 may be found in the 901-1951 Installation and Operating Manual, Part 1.

1.2 SCOPE

This manual contains information necessary for the proper maintenance of the 901-1951 Product family. The technician is provided with a theory of operation for each module within the unit, plus Fault Analysis charts to aid in trouble-shooting and repair.

1.3 PROPRIETARY STATEMENT

This manual contains proprietary information of Data I/O; it is intended solely for the information and use of parties operating and maintaining the equipment described herein. Such proprietary information may not be used, reproduced, or disclosed to any other parties for any other purpose without the express written permission of Data I/O.

2. 901-1951 SYSTEM

This section of the manual is intended to supplement the Installation and Operating Manual (Part I), in that it provides additional information to aid the service technicians in trouble-shooting and maintaining the unit. It is suggested that the user become familiar with the 901-1951 Installation and Operating Manual prior to proceeding with this section.

2.1 SYSTEM SPECIFICATIONS

Operating Speed - 110 and 300 baud, switch selectable, both reader and punch (other speeds optional).

Transmission - Half and Full-Duplex, asynchronous serial by bit and by character (ECHOPLEX may be provided in lieu of Full-Duplex).

Code - 11 bits at 110 baud and 10 bits at 300 baud (other unit codes and baud rates are optional).

Tape Characteristics

Material - Paper - oiled or unoiled

Tape Form - Roll or Folded, interchangeable.

Tape Width - 1 inch (25.4 mm) standard, .687 inch (17.45 mm) or .875 inch (22.22 mm) optional.

Hole Diameter - Code - 0.072 inch (1.83 mm), Feed - 0.047 inch (1.19 mm).

Alignment - Feed hole and Code hole centers are in-line (six-channel advanced feed is optional).

Channels - 8, 5 (7 and 6 Advanced Feed Hole are Optional).

Tape Supply - Punch Capacity - 8 inch (203 mm) diameter roll with 2 inch (50.8 mm) core, 1,000 feet (304.8 meters) long.

Terminal Interface - RS-232C/CCITT V.24 compatible, DB-25S connector.

MODEM/CPU Interface - RS-232C/CCITT V.24 compatible, DB-25P connector.

Electrical

Voltage - 115 VAC±10% (3-wire, grounded), (901-1951 and 901-1952).
230 VAC±10% (901-1953 and 901-1954).

Frequency - 60HZ ± 2 HZ(901-1951 and 901-1952).
50HZ ± 2 HZ(901-1953 and 901-1954).

Power - 160 watts.

Environmental

Temperature - 5° to 40° C (41° to 104°F) Operating, -40° to 66°C (-40° to 153°F) storage.

Humidity - 5% to 95%, non-condensing.

Noise Level - Feed hole only - 54 db @ 300 baud, all holes - 60db @ 300 baud, measured 40 inches (1 meter) in front of unit.

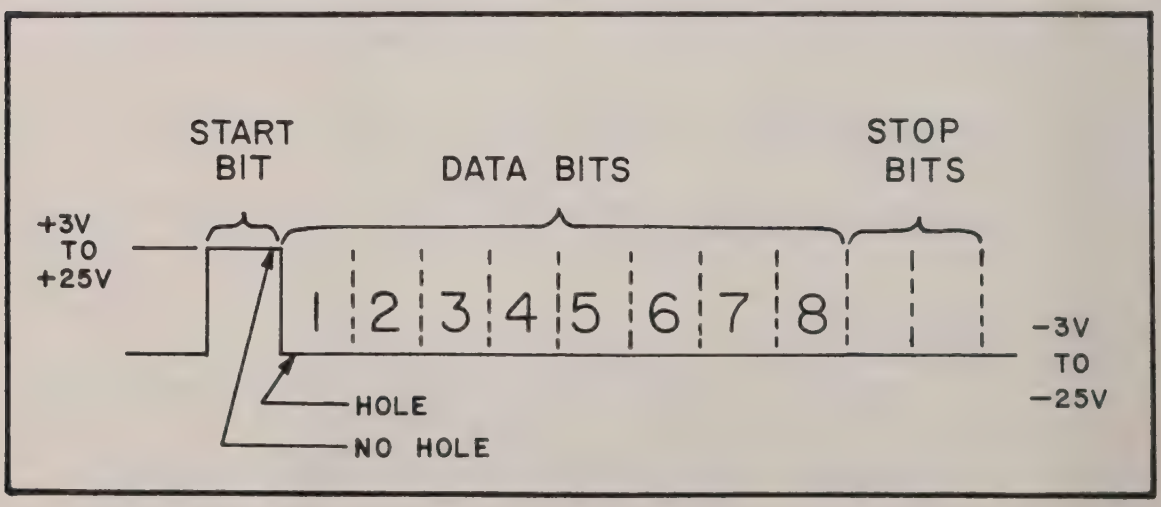
Physical Size - 13 inch (330 mm) wide x 21 inch (533 mm) deep x 6.75 inch (171 mm) high (measured without the tape roll but with chad container installed). The top of a full tape roll is 10 inches (254 mm) above the table surface.

Physical Weight - 30 lbs. (13.6 kg) net; 37 lbs. (16.8 kg) shipping.

2.2 INTERFACE SIGNAL DEFINITIONS

For all input and output signals, the 901-1951 follows the EIA RS-232C & CCITT V.24 specifications for defining all signal levels. Data signals are defined as either Mark or Space, while control signals are either On or Off. The voltage level for a Mark or Off condition is -3V to -25V whereas the level for a Space or On condition is +3V to +25V (see Figure 2-1). A majority of the equipment which uses RS232 interconnections, uses -12V and +12V as standard signal levels; this is also the case with the 901-1951 output signals.

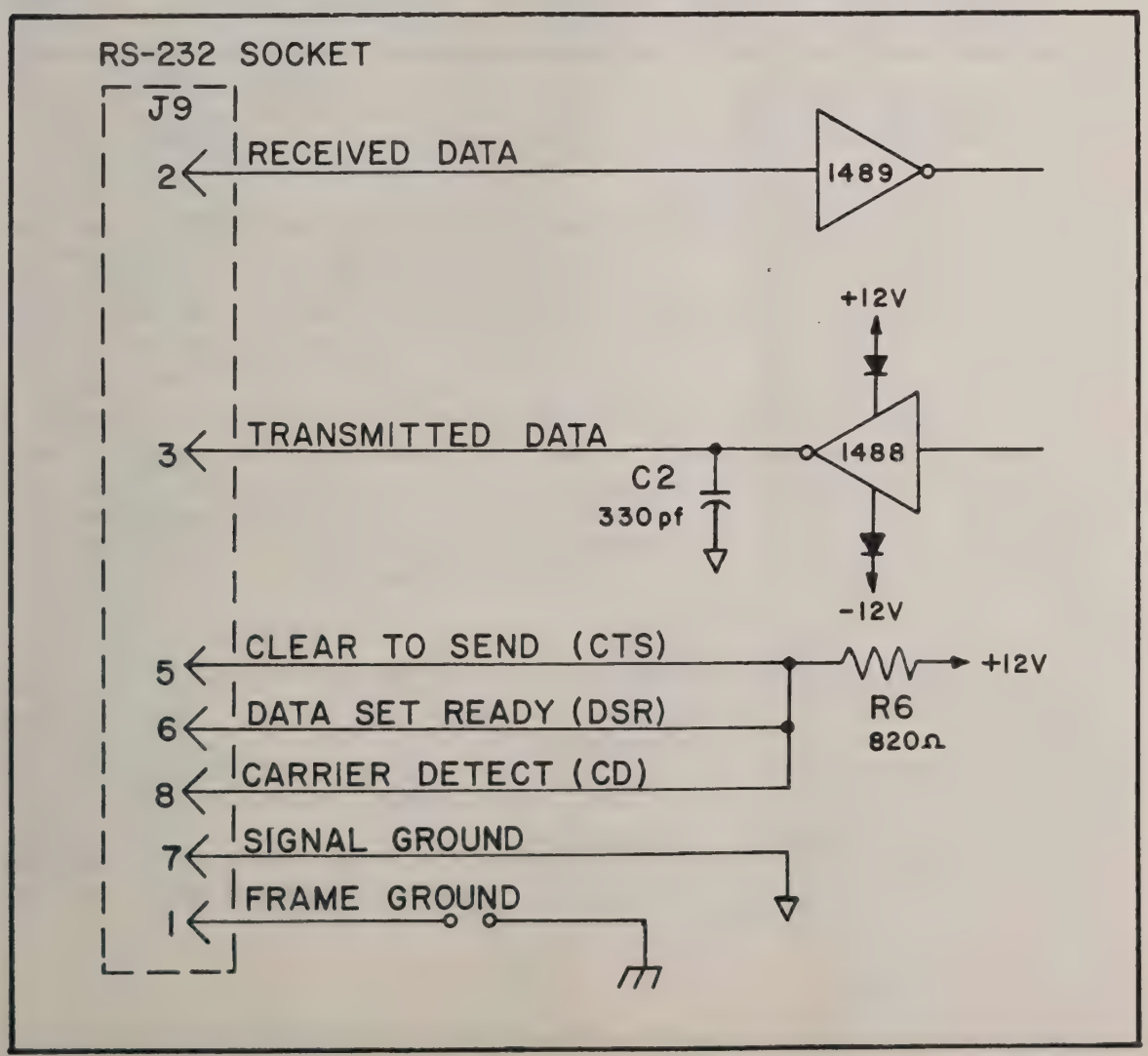
For the technician who is familiar with common teletype signals, the data signals formatter per RS232 are inverted while the control signals maintain a positive true logic. Data signals consist of a start bit/Space; data bits and one, one and one half or two stop bits/Marks. All input and output data lines of the 901-1951 follow this format. The 901-1951 may have one or two stop bits selected for all but 5 level when one or one and one half stop bits are selected. The 901-1951 is normally factory set at a LOW baud of 110 baud with 2 stop bits and a HIGH baud of 300 baud with 1 stop bit.



EIA Interface Signal Definitions Figure 2-1

2.2.1 TERMINAL INTERFACE

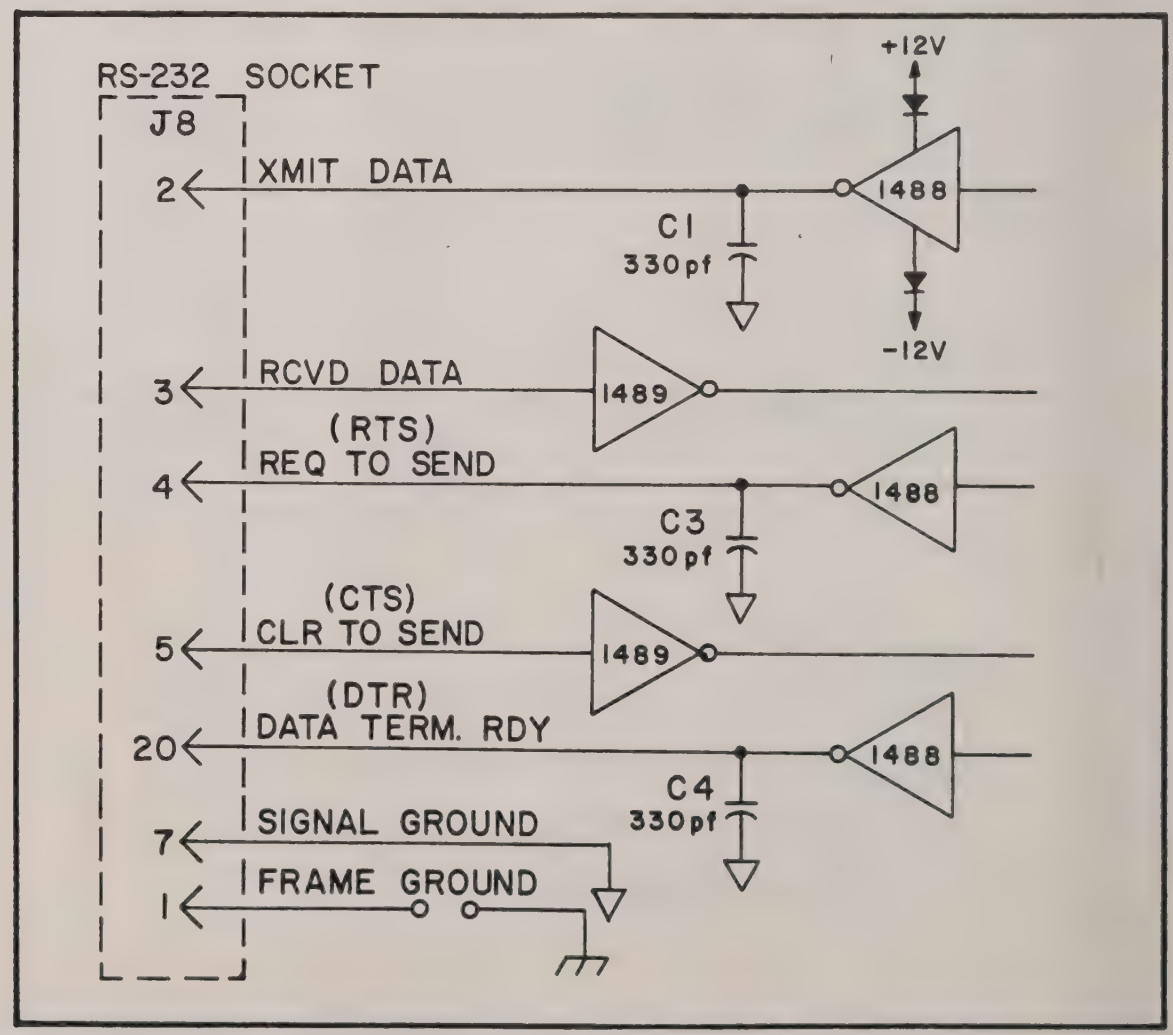
Refer to Figure 2-2, Received Data and Transmitted Data are the EIA formatted data signals to the 901-1951 from the printer/terminal. These signals follow the above mentioned format. The Transmitted Data will be -12V to +12V out of the 901-1951. The three control signals, Clear to Send, Data Set Ready and Carrier Detect are all fixed at an EIA ON condition (+12V). Clear to Send allows an ON condition for the terminal to continue sending data to the 901-1951. Data Set Ready is normally a modem signal that signals the terminal that it is ready to receive transmissions from the terminal. Carrier Detect is also a modem signal that will go to an OFF condition if the modem loses its carrier signal for some reason. The technician should not be concerned about the control signals other than that they allow the printer to transmit to the 901-1951. One caution note should be brought out here, that is that none of the control signal lines (CTS, DSR & CD) should source more than 5mA of current. The Signal Ground line serves as the voltage reference line between the interfaced units.



Terminal Interface Connections Figure 2-2

2.2.2 MODEM INTERFACE

Refer to Figure 2-3, the data signals (Received Data and Transmitted Data) are EIA formatted signals to the 901-1951 from the Modem/CPU. These signals also follow the above format and output levels for Transmitted Data (-12V to +12V) to the modem. Request to Send is a control signal from the 901-1951 to the modem. It is in an ON condition (+12V) when the 901-1951 is in the LINE mode and the reader is active. RTS signals the modem that the unit is ready to receive data. Clear to Send is a control signal from the modem to the unit, as long as this line is at an ON condition, the unit will be allowed to continue sending data to the Modem/CPU. Should the Clear to Send line drop to an OFF condition, the 901-1951 will be inhibited from transmitting new data. Signal Ground is the voltage reference line between the Modem/CPU and the 901-1951. The Data Terminal Ready control line will allow communication between the Modem/CPU and 901-1951 as long as the line is in an ON condition (+12V); however, when it is desired to process a tape off line or locally, and the LINE/LOCAL mode switch is switched to LOCAL, the Data Terminal Ready line goes to an OFF condition (-12V) and signals the Modem/CPU that communication with the unit is not possible.



Modem/CPU Interface Connections — Figure 2-3

2.3 OPERATIONAL DESCRIPTION

The Installation and Operating Manual covers the control switches and their functions, while the Data Flow Block Diagram, Figure 2-4, clarifies the use of the controls by showing the paths that data may follow into and out of the 901-1951 in different modes of operation.

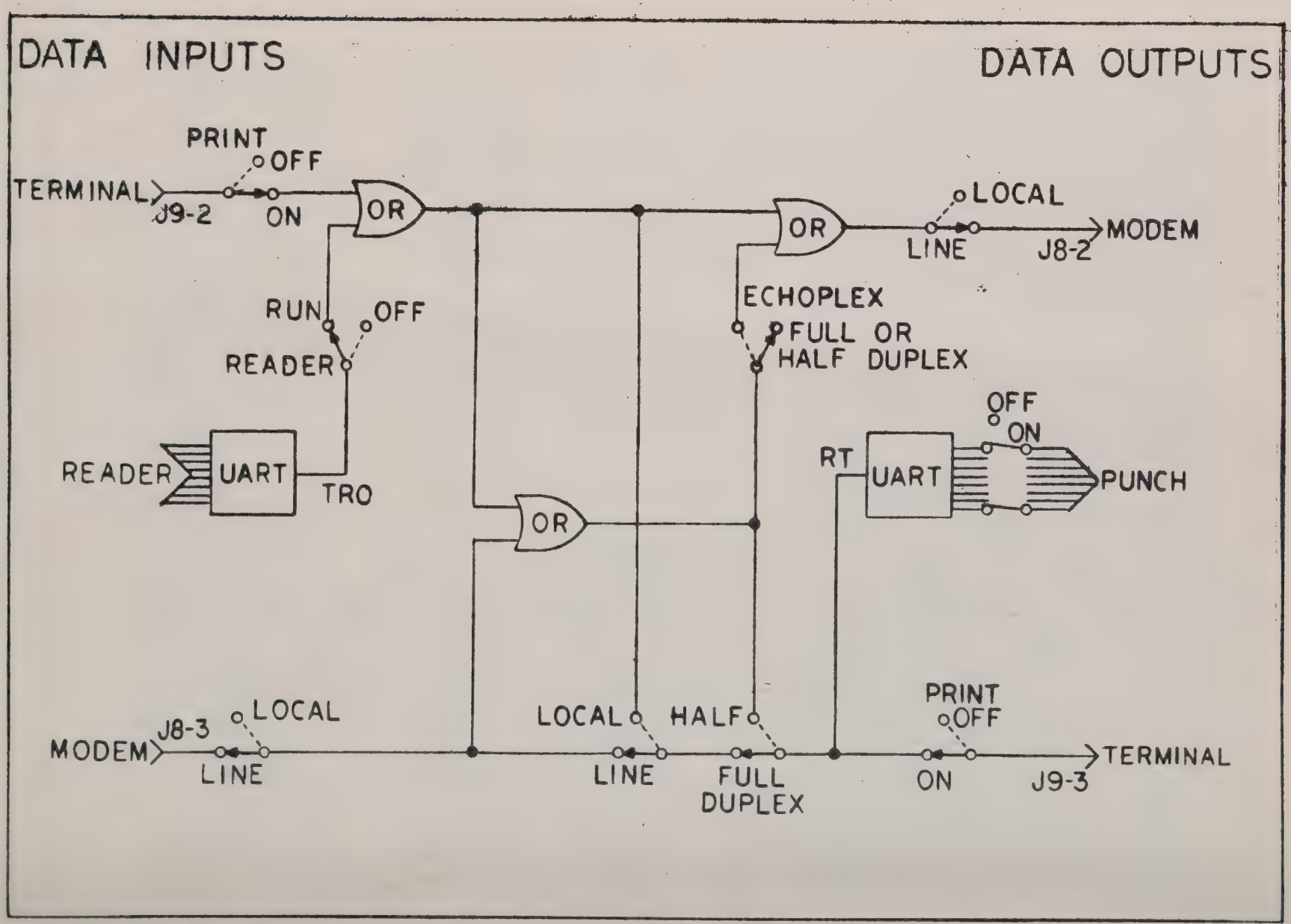
Let us assume that the 901-1951 is used with a KSR teletype to produce tapes locally and then transmit them in Full Duplex to a Modem. After the tape is prepared, the unit is switched to the LINE mode of operation. Tape is loaded into the Reader with the first character to be transmitted directly over the phototransistor array. The Terminal is allowed to have data received by pressing the PRINT ON switch. The unit should be set to the correct baud rate, either HIGH or LOW; it should be in FULL duplex and on LINE. Pressing the RUN switch will start the reader running (if CTS from the modem is present). The path for data to the Modem is through the logical OR gate, allowed access by the LINE switch and out to the Modem. Because the unit is in the LINE mode, data may be received from the Modem and have access to the Terminal. Should it be desired that a tape be punched of the data from the Modem, pressing the PUNCH ON switch will enable the Moduperf perforator mechanism and a tape will be punched of all data received. Referring to the Data Inputs of the block diagram, it is important to note that it is possible, because of the configuration of the OR gate, to be reading a tape and then type over this data from the Terminal if the PRINT switch is on. It is therefore suggested that the Terminal keyboard not be touched when reading a tape.

Now let us assume that the 901-1951 is being used again with a KSR teletype and Modem in the HALF duplex mode of operation. From the block diagram, we can see that data may flow from either the Terminal, Reader or Modem to the Modem, Punch or Terminal. In this mode of operation, everything that is sent or received may be viewed at the Terminal and/or punched as a tape. Data may only be Transmitted or Received at any one time.

Now we'll view the 901-1951 in the LOCAL mode of operation. Note that in LOCAL, no data is transmitted or received by the Modem; also that irregardless of FULL or HALF duplex switch position, the data only flows from either the Terminal or Reader to the Punch or Terminal. This allows for the preparation or editing of a tape 'off line'. Whenever the 901-1951 is in the LOCAL mode, the output to the Modem is held at an EIA Mark Condition (-12V).

2.4 SYSTEM BLOCK DIAGRAM

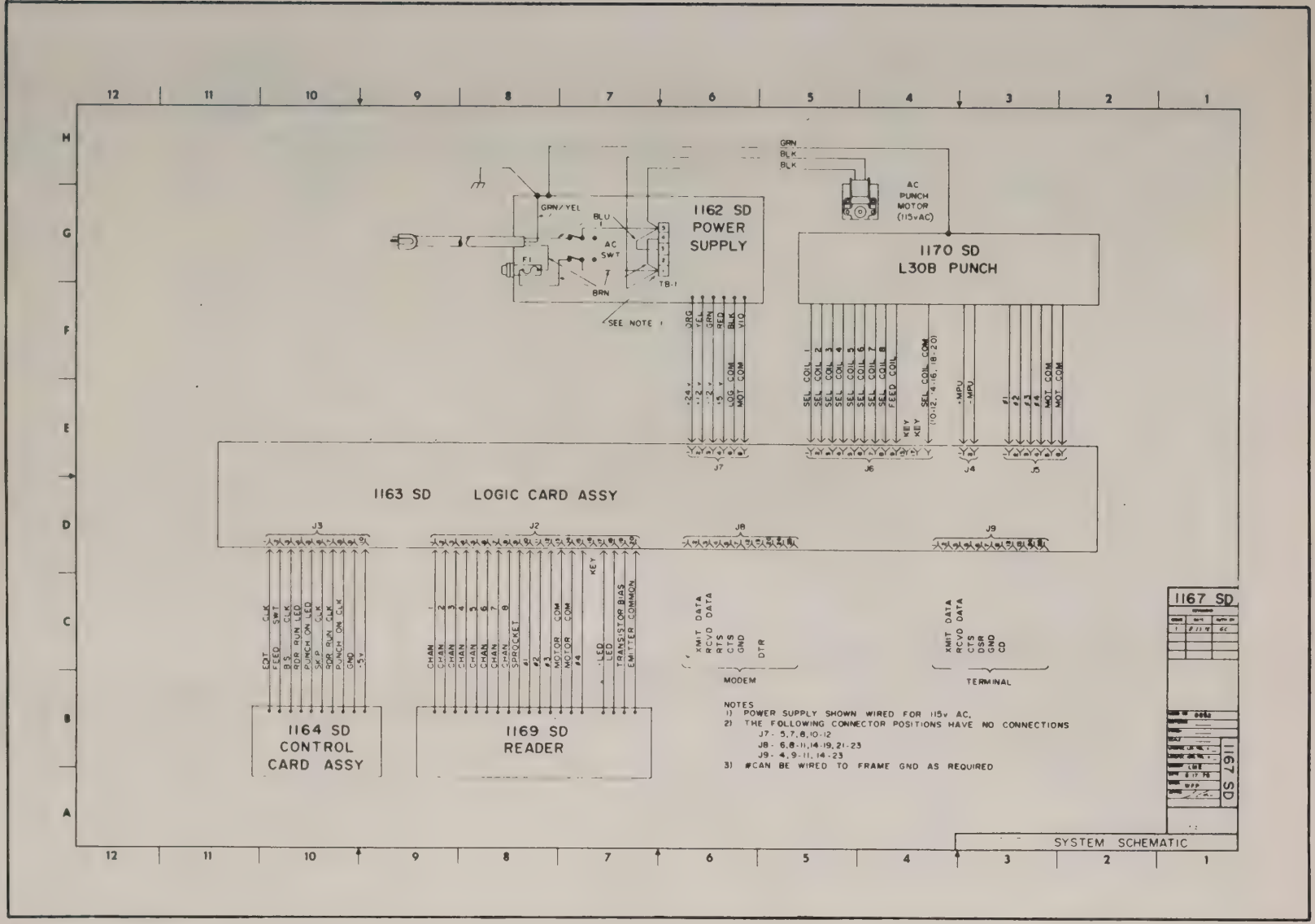
Refer to Figure 2-5; this diagram shows all of the internal interconnections of the 901-1951. The AC power goes to the power supply via the main ON/OFF switch. DC power is distributed to the system through the main logic board via J7. All system modules and I/O connections terminate at the main logic board. The diagram also shows system signal functions along with appropriate connector pin assignments. Note that the ground wire from the punch is terminated at the power supply along with the AC cord ground, providing safety against personal shock to the user.



026-1951
2-6

901-1951 Data Flow Block Diagram

Figure 2-4



901-1951 Schematic

Figure 2-5

2.5 DISASSEMBLY AND ASSEMBLY PROCEDURES

When it becomes necessary to disassemble the 901-1951 for servicing, the unit should be disconnected from the Modem and Terminal; the AC power cord must be disconnected. Refer to Figure 2-6, remove the tape from the punch mechanism and remove the plastic cover by loosening 3 screws (the cover is slotted so that complete removal of the screws is not necessary).

> CAUTION: Voltages dangerous to life are present within the unit.

2.5.1 LOGIC BOARD REMOVAL

Refer to Figure 2-12, page 2-20, to remove the logic board, disconnect the Modem and Terminal plugs and remove the cover. Remove the switch plate (8869) and control board (8847). The cables at the back of the board are easily removed (squeeze the connector tabs to remove plugs). Two hex head screws hold the board in place, one at each bracket; loosen the screws and slide the board towards the rear of the unit.

2.5.2 POWER SUPPLY REMOVAL

If it is necessary to have full access to the power supply, it will be necessary to remove the power supply from the base assembly. Locate the interconnecting cable to the Logic Board, squeeze the locking tabs and unplug the connector from the Logic Board. The power supply is attached to the base by three bolts (Figure 2-6).

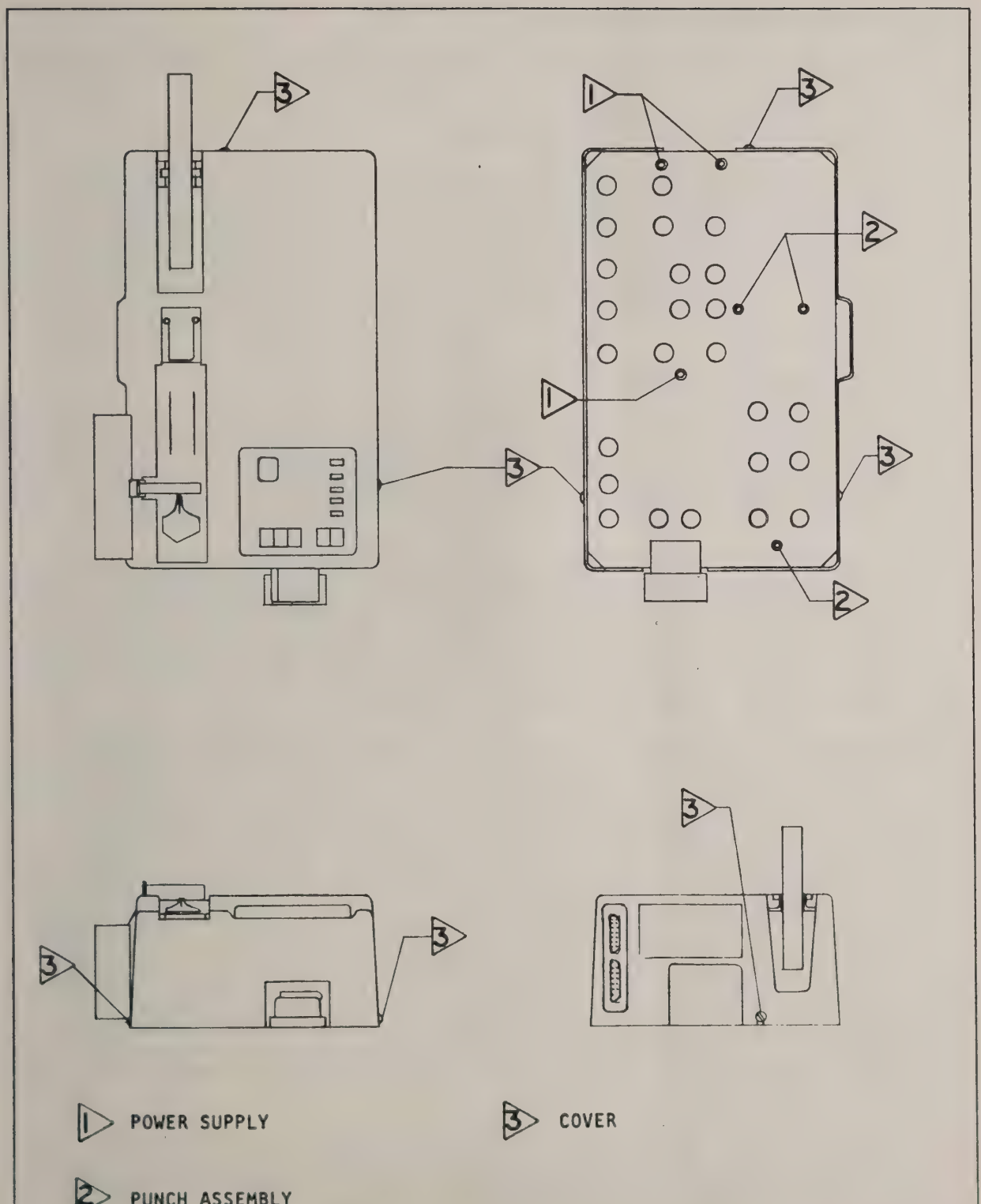
> CAUTION: Be sure when positioning the power supply, that the voltage regulators or AC terminal block connections DO NOT short to the chassis or any other circuit.

2.5.3 MODUPERF L30B REMOVAL

All adjustments to the Moduperf perforator mechanism may be accomplished once the cover is removed; however, should it be necessary to remove the punch from the base, disconnect the magnetic pickup, stepping motor and selector module cables from the Logic Board (squeeze locking tabs to remove plugs). The AC power cord should be unplugged, then connection of the drive motor wiring should be noted (note wire color and terminal number) and wiring removed from the power supply terminal block. Disconnect the ground wire at the punch. Now loosen and remove the 3 bolts holding the punch mechanism to the base (these bolts are at the bottom of the base, Figure 2-6).

2.5.4 REASSEMBLY

Assembly of any level of the 901-1951 should be accomplished by following the disassembly instructions in reverse order. Pay particular attention that ground wires are reconnected, that no cables are touching moving mechanical parts or hot components. The System Schematic, page 2-7, will aid in reassembly and proper cable routing.



Disassembly Hardware Locations

Figure 2-6

2.6 ADJUSTMENTS/FIELD CHANGES

After the 901-1951 is in the field, it may be necessary to perform some adjustments or changes in order to use the unit effectively in its installation.

2.6.1 CARRIAGE RETURN DELAY ADJUSTMENT

Built into the 901-1951 is a carriage return detect circuit that will momentarily delay continued reading of an 8 level or 5 level tape until the printer carriage has had ample time to return to the left margin of the paper. This circuit is factory set at 10mS but may be adjusted to a maximum 1 second delay. Access to the CR adjustment potentiometer is through a hole in the rear panel of the unit, see Figure 2-6 for location. Refer to the procedure outlined in Paragraph 2.7 of the 901-1951 Installation and Operating Manual (Part 1) to make this adjustment.

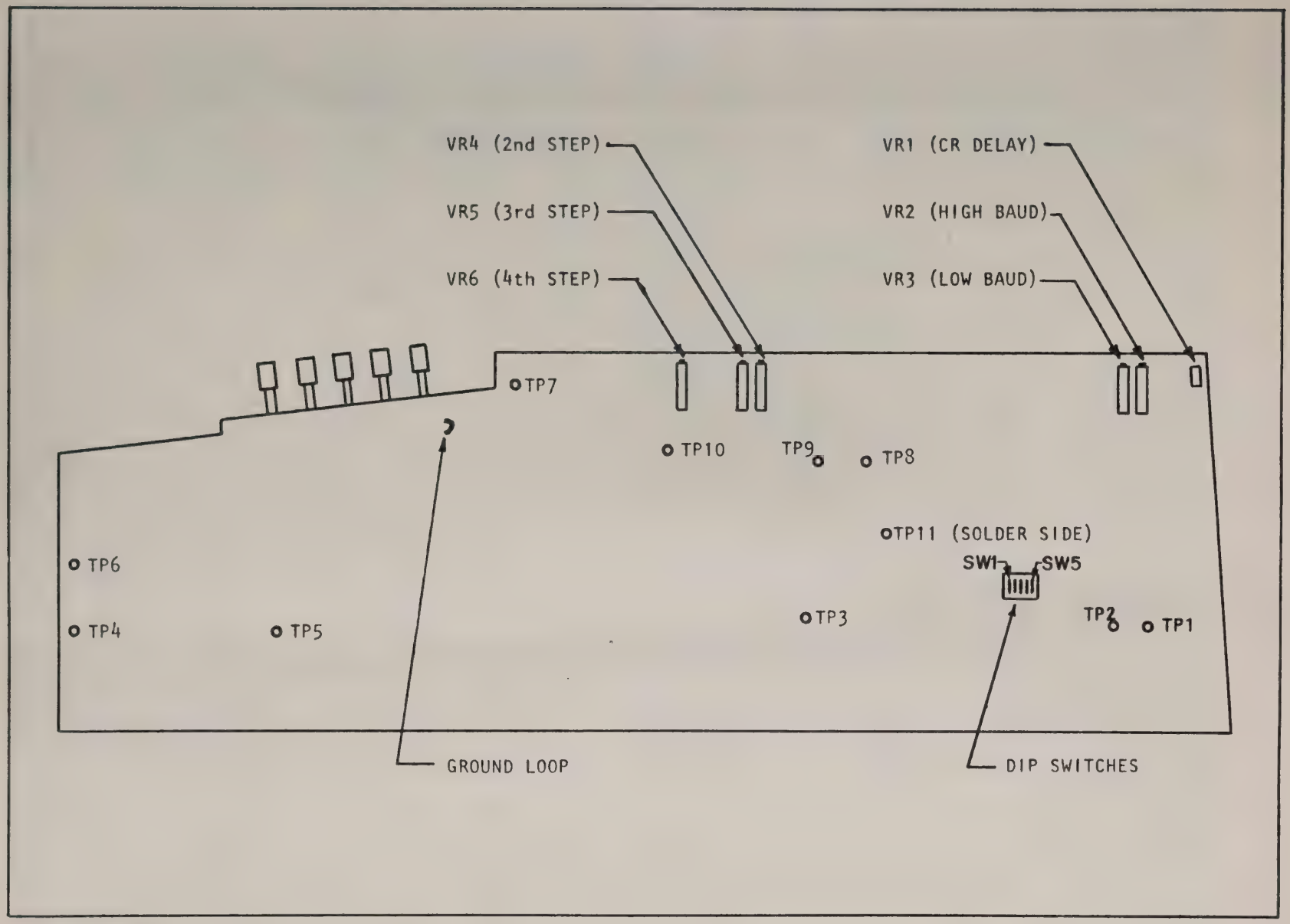
2.6.2 BAUD RATE CHANGES

The 901-1951 is normally set at 110 baud and 300 baud for the low and high baud rates respectively. In actual field applications, though, different baud rates may be desired to interface the 901-1951. Baud rates may be readjusted to any desirable baud rate between 45 to 120 for LOW and 75 to 300 for HIGH baud switch selection.

To perform a readjustment of a baud rate, it will be necessary to gain access to the inside of the unit by removing the cover. Refer to Figure 2-7 to locate the baud rate adjustment potentiometers (VR2 and VR3) and Test Point TP-3. Using a high input impedance oscilloscope or frequency counter, connect the ground lead from the test instrument to the ground loop provided on the Logic Board. Connect the probe to TP-3 and adjust the instrument for a 5V signal of 500 to 5KHz frequency or a 200uS to 2mS period.

Now refer to Table 3-1, 901-1951 BAUD RATES and locate the desired baud rates. The table provides a conversion to characters per second for both low and high baud rates as well as the period and frequency of the baud rate timer. (Note that both transmit and receive sections utilize the same timing network. Because the punch can not operate faster than 30 characters per second, there are some baud rates which should not be used when setting the unit up for 5, 6 or 7 level characters.) Suppose we desire that the LOW baud rate will be at 10 characters/second with 8L and 11 unit code. The table indicates that this will be 110 baud and that the baud rate timer should be set for 1760Hz or a period of 568.2uSec. Once you have determined the correct timer frequency for the low baud rate, press the baud rate pushbutton to LOW and adjust VR3 to obtain the correct frequency/period, then press the baud rate pushbutton again (HIGH BAUD) and adjust VR2 for the correct high baud rate frequency. Frequency settings should be as close to table callouts as possible. After adjustments are complete, potentiometers VR3 and VR2 should be glyptoled so settings do not change.

Any character or baud rate not listed in the table may have the appropriate frequency/period calculated as follows: multiply the character rate by the unit code to arrive at the baud rate, the timer frequency is 16 times the baud rate and the period is the inverse of the frequency.



Variable Resistor and Test Point Locations

Figure 2-7

TABLE 2-1 901-1951 BAUD RATES

BAUD RATE	CHARACTERS PER SECOND								BAUD RATE TIMER	
	Level	5L		6L		7L		8L		Period	Freq
	Unit Code	7	7½	8	9	9	10	10	11	(uSec)	(Hz)
45.0		6.43	6.00	5.63	5.00	5.00	4.50	4.50	4.09	1388.9	720
50.0		7.14	6.67	6.25	5.56	5.56	5.00	5.00	4.55	1250.0	800
51.2		7.31	6.83	6.40	5.69	5.69	5.12	5.12	4.65	1221.7	819
55.0		7.86	7.33	6.88	6.11	6.11	5.50	5.50	5.00	1136.4	880
56.3		8.04	7.51	7.04	6.26	6.26	5.63	5.63	5.12	1110.1	901
57.6		8.23	7.68	7.20	6.40	6.40	5.76	5.76	5.24	1085.1	922
60.0		8.57	8.00	7.50	6.67	6.67	6.00	6.00	5.45	1041.7	960
66.7		9.53	8.89	8.34	7.41	7.41	6.67	6.67	6.06	937.0	1067
70.0		10.0	9.33	8.75	7.78	7.78	7.00	7.00	6.36	893.9	1120
73.3		10.5	9.77	9.16	8.14	8.14	7.33	7.33	6.66	852.7	1173
74.2		10.6	9.89	9.28	8.24	8.24	7.42	7.42	6.75	842.3	1187
75.0		10.7	10.0	9.38	8.33	8.33	7.50	7.50	6.82	833.3	1200
80.0		11.4	10.7	10.0	8.89	8.89	8.00	8.00	7.27	781.3	1280
85.0		12.1	11.3	10.6	9.44	9.44	8.50	8.50	7.73	735.3	1360
90.0		12.9	12.0	11.3	10.0	10.0	9.00	9.00	8.18	694.4	1440
100.0		14.3	13.3	12.5	11.1	11.1	10.0	10.0	9.09	625.0	1600
110.0		15.7	14.7	13.8	12.2	12.2	11.0	11.0	10.0	568.2	1760
112.5		16.1	15.0	14.1	12.5	12.5	11.3	11.3	10.2	555.6	1800
120.0		17.1	16.0	15.0	13.3	13.3	12.0	12.0	10.9	520.8	1920
127.5		18.2	17.0	15.9	14.2	14.2	12.8	12.8	11.6	490.2	2040
130.0		18.6	17.3	16.3	14.4	14.4	13.0	13.0	11.8	480.8	2080
140.0		20.0	18.7	17.5	15.6	15.6	14.0	14.0	12.7	446.4	2240
150.0		21.4	20.0	18.8	16.7	16.7	15.0	15.0	13.6	416.7	2400
160.0		22.9	21.3	20.0	17.8	17.8	16.0	16.0	14.5	390.6	2560
165.0		23.6	22.0	20.6	18.3	18.3	16.5	16.5	15.0	378.8	2640
170.0		24.3	22.7	21.3	18.9	18.9	17.0	17.0	15.5	367.7	2720
180.0		25.7	24.0	22.5	20.0	20.0	18.0	18.0	16.4	347.2	2880
190.0		27.1	25.3	23.8	21.1	21.1	19.0	19.0	17.3	329.0	3040
200.0		28.6	26.7	25.0	22.2	22.2	20.0	20.0	18.2	312.5	3200
210.0		30.0	28.0	26.3	23.3	23.3	21.0	21.0	19.1	297.6	3360
220.0			29.3	27.5	24.4	24.4	22.0	22.0	20.0	284.1	3520
225.0			30.0	28.1	25.0	25.0	22.5	22.5	20.5	277.8	3600
230.0				28.8	25.6	25.6	23.0	23.0	20.9	271.7	3680
240.0				30.0	26.7	26.7	24.0	24.0	21.8	260.4	3840
250.0					27.8	27.8	25.0	25.0	22.7	250.0	4000
260.0					28.9	28.9	26.0	26.0	23.6	240.4	4160
270.0					30.0	30.0	27.0	27.0	24.5	231.5	4320
280.0							28.0	28.0	25.5	223.2	4480
290.0							29.0	29.0	26.4	215.5	4640
300.0							30.0	30.0	27.3	208.3	4800

2.6.3 STOP BIT SELECTION

The 901-1951 is normally preset for one stop bit in the HIGH baud switch position and two stop bits in the LOW baud switch position (DIP switch SW3 OFF, SW4 ON). The selection of stop bits is accomplished by gaining access to the Logic Board Assembly (remove cover) and using DIP switches SW3 and SW4 to set in the desired stop bits.

TABLE 2-2

STOP BIT SELECTION			
BAUD SWITCH	DIP SWITCH SETTING	CODE	
		5L	8L
LOW	SW 3 ON	1	1
LOW	SW 3 OFF	1½	2
HIGH	SW 4 ON	1	1
HIGH	SW 4 OFF	1½	2

Also see Figure 4-1, Page 4-3 for switch programming.

In all cases (except 5 level selection), a switch in the ON position will cause UART transmission to contain one (1) stop bit while the OFF position will cause two (2) stop bits to be transmitted. Note from Table 2-2 that only 1½ stop bits are transmitted when a switch is set for 2 stop bits and the unit is also set for 5 level.

2.6.4 5 LEVEL CONVERSION

The 901-1951 is normally provided as an 8 level reader/punch which can easily be converted to or from 5 level operation in the field. Conversion consists of changing punch tape guides, reader guide pin and reprogramming the logic board. Remove the cover.

Punch conversion is best accomplished by following the instructions for Die Block Changes in section 7 of Part 2 of this manual. The die block is removed from the punch frame, then the die block guide is removed, inverted (number 5 showing on guide) and reinstalled on the block. After the die block is reinstalled, the two tape guide brackets behind the die block are repositioned.

Refer to Figure 2-8 to convert the reader. Figure A shows the reader set up for 8 level tape; note the two tape guide pins at the sides of the tape. To set the reader for 5 level tape, carefully grip the lower guide pin with a pair of pliers and with a slight twisting motion, pull the pin out. Figure B shows the hole location for reinserting the guide pin for 5 level tape. Gently press the guide pin into the appropriate hole.

The logic board is programmed via the DIP switch, SW1 to SW5 (see Figure 2-7). Refer to the programming label on the inside of the cover and set SW1 and SW2 for the desired level (8/5). Use SW3 and SW4 to select the number of stop bits to be transmitted. SW5 should remain ON unless the 901-1951 is to operate in ECHOPLEX instead of FULL duplex mode. Now that the switches are

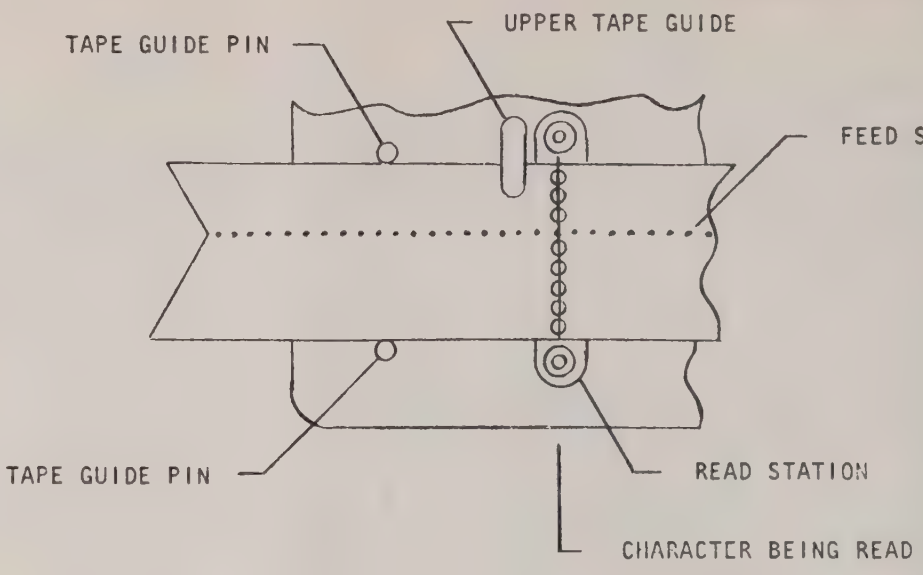


Figure A - 8 LEVEL

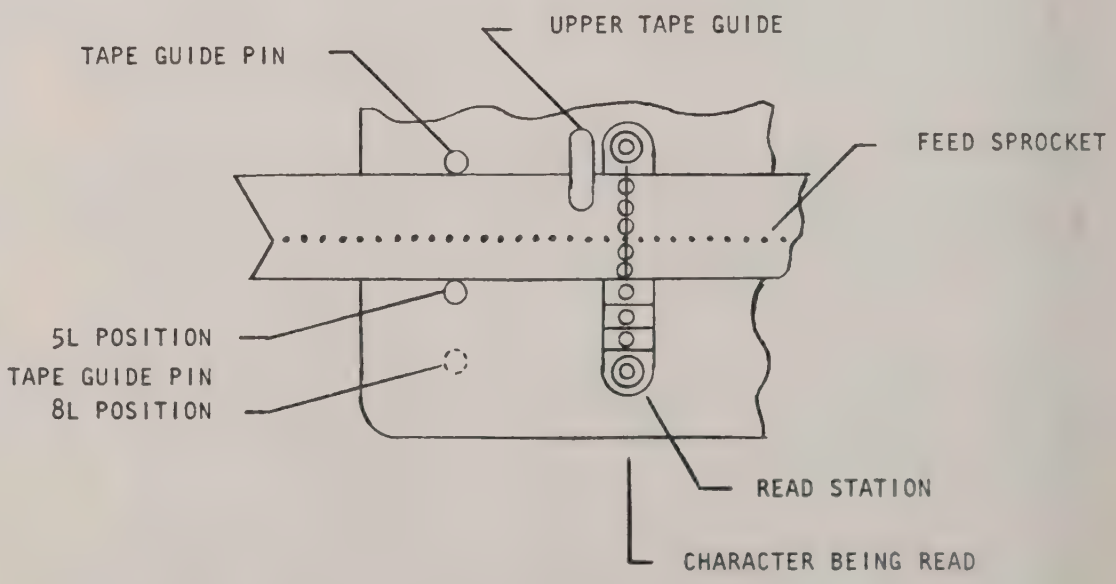
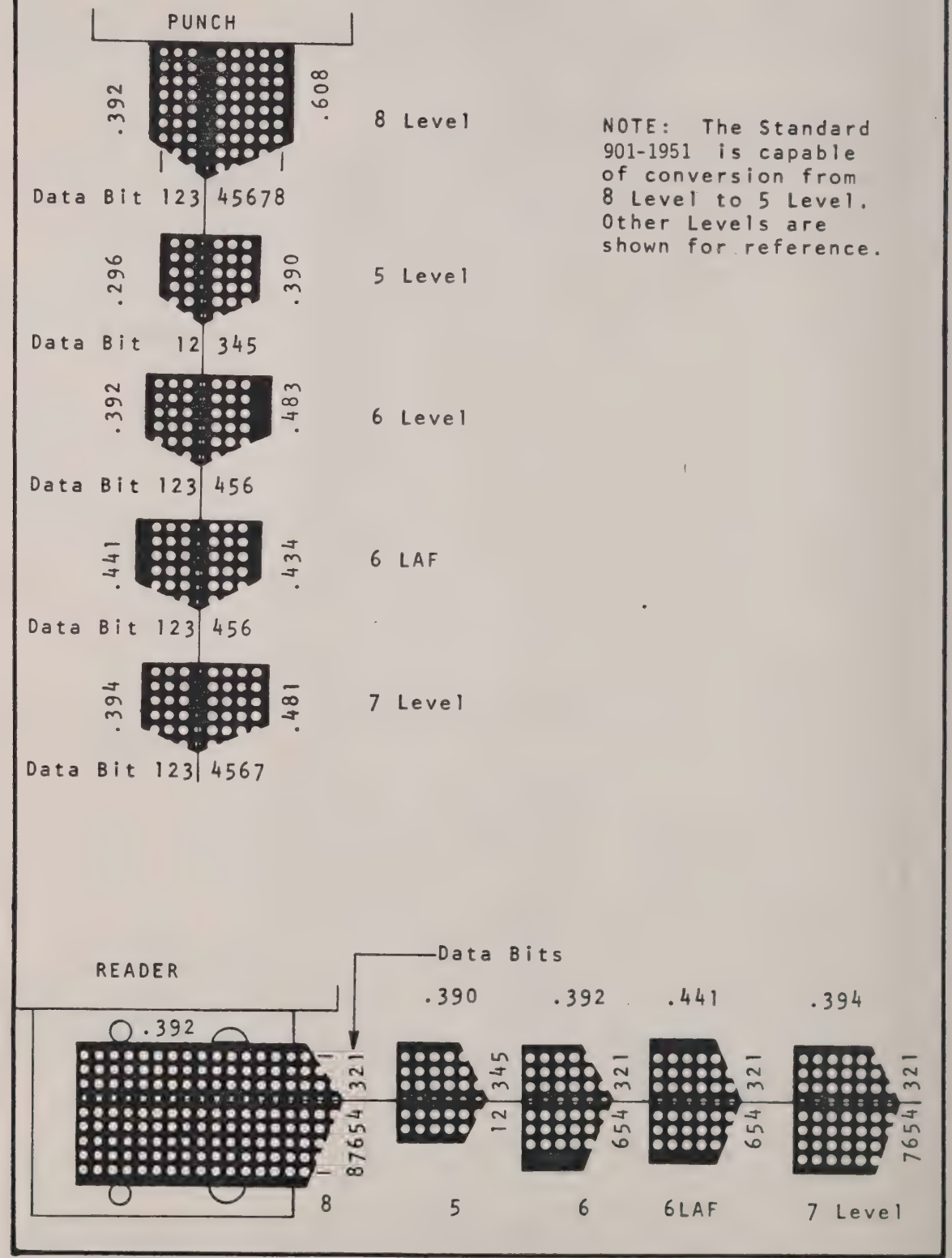


Figure B - 5 LEVEL

properly set, refer to Section 2.6.2 and readjust the baud rates. Reinstall the cover and remark the system label for 5 channel, current baud rates and unit codes.

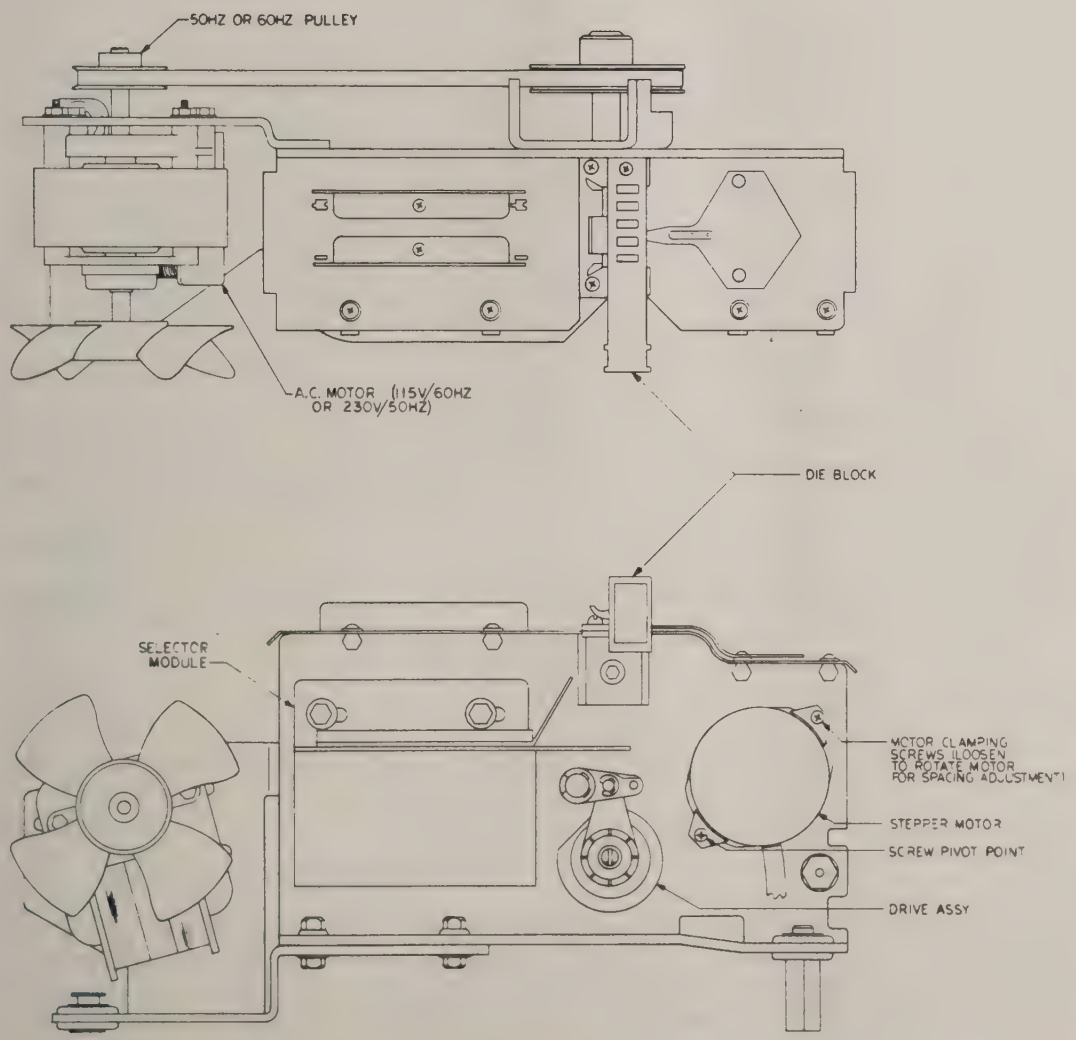
2.7 TAPE ORIENTATION AND BIT ASSIGNMENT

Figure 2-9 illustrates the tape orientation in relation to the punch and reader. Also illustrated is the Data Bit - code hole relationship.



Tape Orientation and Bit Assignment

Figure 2-9



Moduperf Module Identification

Figure 2-10

3. PREVENTIVE/CORRECTIVE MAINTENANCE

Maintenance functions for the 901-1951 can be divided into 3 categories. Preventive Maintenance, which consists of the general cleaning of the unit and modules, lubricating mechanical components and the visual inspection of modules and the unit. Operational Checks exercise various system functions for early detection of faults and to verify proper system operation. Corrective Maintenance actions resolve faults by the replacement of components or modules or by adjustments.

In order for the service technician to properly perform all possible maintenance tasks, he should be equipped with the following tools and test equipment.

TOOLS REQUIRED

Screwdriver, Regular, 1/32 x 1/4" Blade	Thickness Gage .002"
Screwdriver, Phillips No. 1	Thickness Gage .005"
Screwdriver, Phillips No. 2	Thickness Gage .012"
Nutdriver, 3/16"	Hex Head Wrench .035"
Nutdriver, 1/4"	Hex Head Wrench .050"
Nutdriver, 5/16" (OD .450 Max.)	Hex Head Wrench .062"
Nutdriver, 11/32"	Hex Head Wrench 1/8"
Nutdriver, 3/8"	Hex Head Wrench 3/16"
Scale, 6" with 0.1" Graduations	Small, Soft Bristle Brush
Longnose Pliers	Wire Cutters
Soldering Iron, 20-35W	Force Gage, 10 oz. (280 Grams) Max.

TEST EQUIPMENT

Oscilloscope, Dual Trace 15 MHz

Frequency Counter, (5KHz) With 1Hz Resolution

Multimeter

3.1 PREVENTIVE MAINTENANCE

The following table list recommended preventive maintenance functions and the appropriate interval for their accomplishment. Note that it is recommended that an Operational Check of the equipment be performed as part of the monthly maintenance, thus insuring proper overall operation of the unit after all other maintenance functions are completed.

TABLE 3-1 RECOMMENDED PREVENTIVE MAINTENANCE

Function	Equipment		
	LRP-300	Moduperf (punch)	Tape Reader
Clean	M	12	AR
Visual Inspection	M	-	6*
Lubricate	-	12	-
Operational Check	M	M	M

Interval (AR-as required, M-monthly, 12-12 months or 250 rolls of tape, 6* 6 months or 500 hours of operation)

3.1.1 901-1951 PREVENTIVE MAINTENANCE

The exterior only of the 901-1951 should be generally cleaned each month; this may be just the removal of dust, lint and chad from the unit proper (use a small brush for hard to get at places). Stubborn spots on the cover may be removed by using a mild detergent solution sparingly.

Visually inspect the unit for any obvious damage which might impair operation or cause a failure; check all cables for fraying, connectors should seat properly. Perform the operational checks (Paragraph 3.2) associated with the particular system configuration that the 901-1951 is used in. Check punched tape for proper spacing. Should any malfunctions be noted, refer to Paragraph 3.3, Corrective Maintenance for repair instructions to remedy the fault.

3.1.2 MODUPERF PREVENTIVE MAINTENANCE

Section 4 of the Moduperf maintenance instructions (Part 2) deals with preventative maintenance of the mechanism. Each year, follow the disassembly instructions of Part 2, Paragraph 3.6; clean, oil and lubricate the modules. With the cover still off of the 901-1951, activate the punch mechanism and visually check its operation. Turn off the punch and complete the reassembly. Perform the Operational Check of the unit (see Paragraph 3.2).

3.1.3 TAPE READER PREVENTIVE MAINTENANCE

The stepping motor of the tape reader requires no lubrication. The clear plastic covers over the infrared diode and phototransistor arrays should be clear of lint or paper fibers for reading correct data. These areas should be cleaned as required using a clean lint free cloth or soft bristle brush. Periodically inspect the reader for physical damage.

3.2 OPERATIONAL CHECKS

Since a 901-1951 can be used, (a) with a modem and terminal, (b) with a terminal only, (c) with a modem only, or (d) alone, the operational checks that may be performed depend upon the overall system configuration. If at all possible, the 901-1951 should be connected to both a modem and terminal in order that all

functions of the unit may be verified. The operational checks described below are designed for checking 8 level 901-1951's. Should your unit be set up for 5 level, no control codes (DC1-DC4) can be checked but a carriage return may be. A 5 level test tape should be formatted following the same outline as Table 3-2. In order to facilitate operational checks, it is recommended that a Test Tape be prepared in advance. When properly used this tape will allow the service technician to exercise all functions of the 901-1951 as well as providing message data to the printer for its performance appraisal. The tape should be punched using the TEST TAPE FORMAT below.

TABLE 3-2 TEST TAPE FORMAT

6 inches of leader tape (FEED holes)

U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*

Control T (DC4 - Punch Stop)

CR (Carriage Return)

LF (Line Feed)

U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*U*

CR

LF

The quick brown fox jumps over the lazy dog's back. 0123456789

CR

Control S (DC3 - Reader Stop)

Control R (DC2 - Punch Start)

10 Delete (Rub Out) Characters

CR

LF

Control Q (DC1 - Reader Start)

THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG'S BACK. 0123456789

CR

LF

6 inches of leader tape (FEED holes)

Once the tape is prepared, reading the tape will result in the following print out:

U*U*U*

3.2.2 901-1951 TERMINAL OPERATIONAL CHECKS

Turn on the printer/terminal then turn on the 901-1951. The PUNCH ON and reader RUN LED should come on (the RUN LED will extinguish after approximately 1 second). Turn off the punch and remote control functions. Make sure the baud rate switch is set to that used by the printer. Select FULL duplex and LINE mode of operation. Operate the terminal keyboard and observe that no data is being printed by the terminal. Select HALF duplex mode of operation and again operate the terminal keyboard; observe that data is now being printed at the terminal. Select LOCAL mode of operation. Operate the terminal keyboard and observe that data is being printed at the terminal. Both FULL and HALF duplex modes plus LOCAL operation have been checked.

Load the TEST TAPE into the reader; turn on the reader and verify that the printer data is correct by comparison with the sample print out above. Pressing the Reader RUN pushbutton will turn the reader alternately off and on, this should only result in the message stopping and starting again; no character errors should be seen on the printer. Reader and reader circuitry have been checked.

Stop the reader and reload the TEST TAPE. Turn on the remote control function by pressing the REM. CTL. pushbutton. At the terminal keyboard, type a control (CNTL) 'R' character and verify that the punch has come on by observing the LED on the PUNCH ON pushbutton. Now type in a control (CNTL) 'Q' character which should cause the RUN LED to light and the reader to start reading the TEST TAPE. The punch will punch the first line of U* and then stop while the terminal prints both lines of U* and the first line of 'Fox' test, then stops. Now momentarily press the EDIT pushbutton; the punch should again turn on. Press and hold the EDIT pushbutton; several delete (rubout) characters will be punched with a carriage return which will stop the reader. Momentarily press the EDIT pushbutton again, this will cause the reader to RUN again, and the punch and terminal will duplicate the last 'Fox' message line. When the TEST TAPE runs out, the reader will stop. The EDIT and remote control (REM. CTL.) functions have been checked.

Switch the baud rate control to the other baud rate and disable data to the terminal by turning off the printer (PRINT OFF), also turn off the REM. CTL. function. Reload the TEST TAPE into the reader and start the reader by pressing the RUN pushbutton. The punch should duplicate the TEST TAPE exactly at the selected baud rate. Operational Checks are now complete. (Note: Modem line circuitry cannot be checked.)

3.2.3 901-1951 MODEM OPERATIONAL CHECKS

Turn on the Modem/CPU and 901-1951. The PUNCH ON and reader RUN LED should come on (RUN LED will extinguish after approximately 1 second). Turn OFF the REM. CTL. Make sure the baud rate switch is set to the system operating rate. Select FULL duplex and LINE mode of operation. Operate the Modem and verify data is being punched at the 901-1951. Load the TEST TAPE into the reader and turn on the reader by pressing the RUN pushbutton. Verify that the TEST TAPE data is being received at the Modem. Reload the TEST TAPE, switch to HALF duplex, turn on the reader (RUN) and verify that the TEST TAPE is being duplicated by the punch. Both HALF and FULL duplex modes have been checked. (Note: Printer line circuitry cannot be checked.)

Switch to LOCAL operation and FULL duplex mode. Reload the TEST TAPE into the reader and turn on the reader (RUN). The punch should duplicate the TEST TAPE exactly. Pressing the RUN pushbutton will turn the reader alternately off and on, this should only result in the tape stopping and starting again; no character errors should be noted in the punched tape. Reader and reader circuitry have been checked.

Stop the reader and reload the TEST TAPE. Turn on the remote control function (REM. CTL.). Turn on the punch (ON) and then turn on the reader (RUN). The punch will punch a line of U* and then stop while the reader continues reading through a second line of U* and one line of 'Fox' test message and then stops. Momentarily press the EDIT pushbutton; the punch should again turn on. Press and hold the EDIT pushbutton; several delete (Rub out) characters will be punched with a carriage return which will stop the reader. Pressing the EDIT pushbutton momentarily twice will cause the reader to RUN again and the punch will duplicate the last 'Fox' test message line. When the TEST TAPE runs out, the reader will stop. The EDIT and REM. CTL. functions have been checked.

Switch to the other baud rate and turn off the REM. CTL. function. Reload the TEST TAPE into the reader and turn on the reader (RUN). The punch should duplicate the TEST TAPE exactly at the selected baud rate. Operational Checks are now complete.

3.2.4 901-1951, OPERATIONAL CHECKS

Turn on the 901-1951; the PUNCH ON and reader RUN LED should come on (RUN LED will extinguish after approximately 1 second). Turn the PRINT and REM. CTL. functions off. Select LOW baud rate, FULL duplex and LOCAL operation. Load the TEST TAPE into the reader and turn on the reader (RUN). The punch should duplicate the TEST TAPE exactly. Pressing the RUN pushbutton will turn the reader off and on, this should only result in the tape and punch stopping and starting without any character errors. Select HIGH baud rate, reload the TEST TAPE into the reader; turn on the REM. CTL. function and turn on the reader (RUN). The punch will punch a line of U* and then stop while the reader continues reading through a second line of U* and one line of 'Fox' test message and then stops. Momentarily press the EDIT pushbutton; the punch should turn on. Press and hold the EDIT pushbutton; several delete (Rubout) characters will be punched followed by a carriage return which will stop the reader. Pressing the EDIT pushbutton momentarily twice, will cause the reader to RUN again and the punch to duplicate the last 'Fox' test message line. When the TEST TAPE runs out, the reader will stop. Operational Checks are now complete. (Note: Line, Modem and Printer functions cannot be checked.)

3.3 CORRECTIVE MAINTENANCE

When a problem is encountered with the 901-1951, the service technician should ascertain if the unit is being operated properly then exercise it to localize the fault. Once localized, refer to the Fault Analysis portion of this section, identify the fault, ascertain probable cause and perform those actions which will remedy the problem. Before attempting to trouble-shoot the 901-1951, the service technician should read and understand how each of the 901-1951 modules operate.

For trouble-shooting purposes, the 901-1951 may be considered as being composed of the following modules: Reader, Punch, Control Functions, and Input/Output Circuitry. Additionally, the punch (Moduperf) mechanism contains three sub-modules: Selector Module, Die Block and Main Frame. Definitely no attempt should be made to adjust the Moduperf Selector Module, Die Block or Mainshaft housing. No adjustments are possible on the tape Reader. These modules (when found faulty) should be returned to the factory.

For those faults which are attributed to the punch mechanism, refer to the Fault Analysis portion of Part 2 (Moduperf Maintenance).

TABLE 3-3, FAULT ANALYSIS

ITEM NO.	FAULT	PROBABLE CAUSE	EXAMINE/REMEDY
1.	Unit will not turn on.	a) Fuse blown b) No +5V power	a) Replace fuse. b) Check +5V power regulator
2.	Incorrect data received or transmitted.	a) Baud rate incorrect b) I/O circuitry Malfunction	a) Adjust baud rate to that being used by the system (2.6.2). aa) Examine baud rate timer circuit. b) Examine I/O circuitry of Logic Card Assembly.
3.	Reader does not run, start, advance, step.	a) Loose or improperly connected cable. b) Defective phase driver c) Stepping circuit malfunction d) Start Stop circuit malfunction e) CR detection circuit malfunction	a) Examine cable for proper polarization and connection to the Logic Card Assembly. b) Examine motor phase drivers. c) Examine C5 for proper phase. d) Examine Start Stop circuit, A2, A3, B2. e) Examine CR circuit, A5, A9, A10, B4C, B5C.
4.	Reader runs continuously or always steps.	a) Start/Stop circuit	a) Examine Start/Stop circuit A2, A3, B2.
5.	Reader continues to run when out of tape	a) Sprocket circuit b) Start/Stop circuit	a) Examine A7C, B5F & TP4 for pulses when reading tape. b) Exercise reader RUN pushbutton and check for proper start/stop activity. bb) Check error detector flip-flop B2B.
6.	Reader runs fast.	a) Shorted +12V to +5V	a) Visually inspect PCA for short, remove.

TABLE 3-3, FAULT ANALYSIS (continued)

ITEM NO.	FAULT	PROBABLY CAUSE	EXAMINE/REMEDY
6.	Reader runs fast.	b) SKIP circuit.	b) Check SKIP circuit C4C, B4A, A3C.
7.	Reader stops sporadically.	a) Intermittent +24V b) Drive circuitry c) Stepper Motor	a) Check power supply +24V b) Check stepping motor drive circuitry. c) Replace entire reader.
8.	Reader stops running after several hours.	a) See 7 above .	a) See 7 above.
9.	Reader drops levels.	a) Loose or improperly connected cable. b) Channel phototransistor. c) Defective Level Buffer	a) Examine cable for proper polarization and connection to Logic Card Assembly. b) Check input to level buffer, if bad replace entire reader. c) Replace level buffer (A7 or A8).
10.	Reader always reads a level.	a) Channel phototransistor. b) Defective Level Buffer.	a) Check input to level buffer (A7 or A8), if bad replace entire reader. b) Replace level buffer (A7 or A8).
11.	Punch does not start.	a) Start/Stop circuit b) Drive motor. c) Drive belt too tight.	a) Exercise start/stop circuit and check action of Flip-Flop A17B, replace if bad. b) Replace drive motor (see Part 2, paragraph 5.4.8). c) Readjust drive belt tension (see Part 2, paragraph 5.4.8).

TABLE 3-3, FAULT ANALYSIS (continued)

ITEM NO.	FAULT	PROBABLE CAUSE	EXAMINE/REMEDY
12.	Punch always punches.	a) Control circuit b) Start/Stop Flip-Flop.	a) Check Control Board SW3, U2. b) Replace A17B.
13.	Punch stops sporadically.	a) Intermittent +24V. b) Drive circuitry. c) Stepping motor.	a) Check +24V power supply. b) Check stepping motor drive circuitry. c) Replace stepper motor (see Part 2, paragraph 5.4.9).
14.	Punch drops levels.	a) Selector coil driver. b) Punch Latch. c) Selector coil. d) Seating of Selector Module.	a) Replace open driver. b) Check operation of B11 or B12, replace defective latch. c) Replace Selector Module (see Part 2, paragraph 4.4.2). d) Position Selector Module properly (see Part 2, paragraph 4.4.2)
15.	Level always punched.	a) Selector coil driver. b) Punch Latch.	a) Replace shorted driver. b) Check operation of B11 or B12, replace defective latch.
16.	Multiple levels punched together.	a) Selector coil drivers. b) Foil path short. c) Reader buffer.	a) Check for drivers shorting together. b) Examine Logic Card Assembly for shorts. c) In LOCAL or HALF duplex, bad A7 or A8 buffers may cause punch to punch multiple levels.

TABLE 3-3, FAULT ANALYSIS (continued)

ITEM NO.	FAULT	PROBABLE CAUSE	EXAMINE/REMEDY
17.	Punch won't come on when unit is powered up.	a) Start/Stop Flip-Flop b) Drive motor.	a) Replace A17B. b) Replace drive motor (see Part 2, paragraph 5.4.8).
18.	Punch runs awhile then drops levels.	a) Selector Module.	a) Position Selector Module Properly (see Part 2, paragraph 4.4.2).
19.	Punch does not feed punched tape out of Die Block.	a) Stepping motor driver. b) Boost drive. c) Step circuit. d) MPU spacing. e) No MPU pulse. f) No steps pulse. g) Phase generation. h) FEED clock.	a) Replace shorted or open driver. b) Check boost drive circuit D12A, Q4, Q5. c) Check for proper step circuit operation. d) Check for MPU pulse, adjust MPU spacing (see Part 2, paragraph 5.4.1). e) Check MPU coil for open, replace. ee) Check MPU pulse circuit (D9, D8). f) Check MPU pulse circuit and step generation. g) Check phase Flip-Flops C10 for proper operation. h) Check Control Board for proper FEED clock operation.
20.	Punch feeds intermittently.	a) PDR from UART. b) Boost driver.	a) Check gate circuit C22C, B16D. b) Check boost driver transistor.
21.	Punch oscillates or Back Spaces continuously.	a) Back Space circuit.	a) Check Back Space circuit for proper operation.

TABLE 3-3, FAULT ANALYSIS (continued)

ITEM NO.	FAULT	PROBABLE CAUSE	EXAMINE/REMEDY
22.	Punch drive motor stops after awhile.	a) Thermal cutoff.	a) Examine unit for proper ventilation.
23.	Punch will not Back Space.	a) B.S. Clock. b) B.S. Circuit.	a) Check Control Board SW1 & U3 for proper operation. b) Check Back Space circuit for REV STEP and proper operation.
24.	Punched tape has even but incorrect character spacing.	a) Character spacing.	a) Adjust stepper motor (see Part 2, paragraph 5.4.9).
25.	Punched tape has erratic character spacing.		a) See Part 2 Item 7 Fault Analysis Table.
26.	For additional Punch mechanism faults refer to Part 2, Fault Analysis Table.		
27.	FEED button does not function.		a) See 19 above.
28.	BACK SP. button does not function.		a) See 23 above.
29.	Punch ON button does not function.		a) See 11 and 12 above.
30.	Punch ON LED always stays on.	a) LED Driver bad. b) Start/Stop Flip-Flop.	a) Replace U1. b) When bad, replace A17.

TABLE 3-3, FAULT ANALYSIS (continued)

ITEM NO.	FAULT	PROBABLE CAUSE	EXAMINE/REMEDY
31.	Punch ON LED never comes on.	a) LED Driver bad. b) Start/Stop Flip-Flop.	a) Replace U1. b) Replace bad A17.
32.	REM. CTL. button does not function.	a) Remote Control circuitry.	a) Check Remote Control circuitry A18, B17, B18, C22, D19.
33.	Reader RUN LED always stays on.	a) Turn off delay. b) LED Driver	a) Check IC C3. b) Replace Control Board U1.
34.	Reader RUN LED always stays on.	a) RUN clock. b) RUN Start/Stop Flip-Flop	a) Replace IC U2 on Control Board. b) Check reader Flip-Flop B2.
35.	Reader RUN LED never comes on.	a) Turn off delay. b) RUN Start/Stop Flip-Flop.	a) Check IC C3. b) Check reader Flip-Flop B2.
36.	Reader RUN button does not function.	a) Reader Start/Stop circuitry. b) Turn off delay.	a) Check circuitry for proper operation. b) Check IC C3.
37.	Reader EDIT button does not function.	a) EDIT clock. b) EDIT circuit.	a) No clock, replace IC U1 of Control Board. b) Check EDIT circuiting for proper operation.
38.	Reader SKIP button does not function.	a) SKIP clock. b) SKIP circuitry.	a) No Clock, replace IC U1 of Control Board. b) Check SKIP circuitry for proper operation.

TABLE 3-3, FAULT ANALYSIS (continued)

ITEM NO.	FAULT	PROBABLE CAUSE	EXAMINE/REMEDY
39.	HIGH baud rate incorrect.	a) Baud timer.	a) Readjust VR2.
40.	LOW baud rate incorrect.	a) Baud timer.	a) Readjust VR3.
41.	Neither HIGH or LOW baud positions work.	a) Divider circuit.	a) Check baud rate divider A17A and associated circuitry.
42.	FULL/HALF duplex positions - won't work.	a) Control circuitry. b) Operator Error.	a) Check Logic Card Assembly control circuitry for proper operation. b) Refer to Data Flow Block Diagram Figure 2-4.
43.	LINE/LOCAL positions - won't work.		a) See 42 above.
44.	No data to printer.	a) PRINT Disabled. b) I/O Circuitry.	a) Turn PRINT on. b) Check C22D and C23D for proper operation.
45.	No data from printer.	a) I/O Circuitry. b) Cabling.	a) Check B22C. b) Check external printer cable.
46.	No data to Modem.	a) LINE mode.	a) Unit must be in LINE mode for data to be transmitted or received.
47.	No data from Modem.		a) See 46 above.

4. LOGIC CARD ASSEMBLY

4.1 CIRCUIT DESCRIPTION

The Logic Card Assembly is the electronic heart of the 901-1951; it provides control of all data to and from the unit as well as conversion of parallel data to serial data and vice versa. It is necessary to follow the schematic diagram while an explanation of each circuit functions is being made. The schematic diagram is located at the end of this section and consists of several pages with the first page used for general notes. Each integrated circuit is designated by a unique mapping system consisting of an alphabetical row designation and a numerical column designation (refer to the assembly drawing, page 4-15. The circuit descriptions that follow will use these designations.

Since the schematic is multiple paged, some signals flow from one page to another; these are designated by a rectangular block with a solid arrowhead depicting incoming or outgoing signals. The four digit numbers within the block describes the page number that the signal originated on and the individual signal number by page; thus, 0402▶ is a signal originating on page 4 of the schematic and is the second signal leaving that page. This arrangement allows for quick referencing between pages of the schematic.

4.1.1 INPUT & OUTPUT CIRCUITS

Refer to page 2 of the schematic. This section of the logic card assembly contains all of the EIA input and output circuits and circuitry for HALF/FULL duplex and LINE/LOCAL control. To follow the path from the printer to the Modem, find J9-2 at the top of the schematic. Serial EIA data into the 901-1951 from the printer enters at connector J9 pin 2, flows through B22C, B21C, B21D, A21B, A22A, and C23B where it exits the unit at Modem connector J8-2. This is the normal data path when the 901-1951 is in LINE and FULL duplex modes of operation. The EIA amplifier stages (B22, C23) convert incoming signals to logic level and outgoing logic level signals to an EIA level (-12V to +12V). Should the LOCAL mode of operation be selected, data is inhibited from flowing through gate A22A by a low (logic '0') level at pin 1. This forces A22A's output to a high (logic '1') which is inverted by amplifier C23B thereby putting a steady -12V (EIA Mark) on the data line, J8-2, to the Modem.

Modem data enters the unit at J8-3, flows through B22B, A19E, B21B, A22B, C22D, C23D and out to the Printer via J9-3. Data will only be allowed along this path if LINE mode operation with PRINT on are selected. If LOCAL mode is selected, data is inhibited from flowing from the Modem through gate B21A by a low (logic '0') level at pin 1. The output of gate A22B is inverted by A20D and provided to the UART for conversion to parallel data for use by the punch; any data that could be sent to the Printer is also available to the punch. Pressing the PRINT pushbutton ON enables gate B21D so data is allowed in from the Printer. Gate C22D is also enabled, allowing data out to the Printer.

Gate A22C enables A22D when HALF duplex or LOCAL is selected. HALF duplex operation allows the printer to receive all data transmitted or received by the unit, therefore, transmission is limited to Modem, then Printer, then Modem, etc. When A22D is enabled, Printer (or reader) data has access to A22B and back out to the Printer (J9-3) besides the normal path to the Modem.

When in the LINE mode of operation, pin 2 of C22A is a logical '1' and if the reader is turned on (RUN), Reader active will be high and C23A's output will be an EIA ON condition on the RTS (request to send) line, J8-4. Also note that as long as the unit is in LINE mode, status flag DTR (data terminal ready) will be ON. At J8-5, the Modem provides a control signal CTS (clear to send) which is inverted by B21A. When CTS goes low (EIA OFF condition) in the LINE mode, the output of B21A, RDR (reader) HOLD, will go low and thus halt the reader from reading another character. A character is the process of being transmitted will be completed prior to transmission halting. As soon as CTS goes high, a new character will be read, transmitted and reader advanced.

The top left corner of the schematic has a signal input TRO which is data from the tape reader which has been serialized by the UART. You will note that both reader data and Printer data are presented as inputs to A21B, therefore whenever data is being transmitted by the reader, the Printer keyboard should not be touched as an errorous composite data will be transmitted. The TRO signal is normally high and enables A21B for Printer data transmission whenever the reader is OFF.

Note the lower left hand corner of the schematic. R5 and C5 form a timing network which produces a power-on-reset (POR) pulse for initializing the 901-1951. When power is first turned on, C5 acts as a short and takes the input to -12V. The output of B22D stays high until the threshold point is reached by the charging of C5 through R5, then the output will go low.

4.1.2 ECHOPLEX OPERATION

Systems set for HALF duplex will provide a copy of transmitted data but there is no assurance that the data was ever received by the distant unit. A 901-1951 used as the distant unit may be set for ECHOPLEX instead of FULL duplex operation by setting DIP switch SW-5 OFF. Then, any data received at the Modem port of the 901-1951 will be retransmitted back to the Modem. In the ECHOPLEX mode, operation is confined to transmission from only one side at a time. Note that if SW-5 is open (OFF), data from the Modem is now enabled through A21A and A21B to be transmitted back to the Modem (J8-2).

4.1.3 UART, REMOTE CONTROL CIRCUITS

Refer to page 3 of the schematic, the 901-1951 communicates with the outside world in serial form but data is read and punched in parallel form. This conversion is accomplished by a Universal Asynchronous Receiver Transmitter (UART for short). The UART may be thought of as two separate circuits contained within the same package; the Transmit portion which converts reader parallel data into serial form, and the Receiver portion which converts data to the Printer from serial form into parallel form for use in punching tapes. Transmission of a character/word is accomplished as follows: parallel data from the Reader (RD-1 to RD-8) is presented to the UART, when a negative pulse (TBRL) is received by the UART, the parallel data is put into a register where start and stop bits are added, then the data word is transmitted out serially via TRO (transmit output). The serial data is fed to the output circuitry (schematic sheet 2) and out to the appropriate device. When a complete word has been transmitted, the UART signals that the transmit register is empty (TRE) with a high level output. The system will then generate a new TBRL

negative pulse to load the next parallel character into the UART. The TRO line is held high when no word is being transmitted.

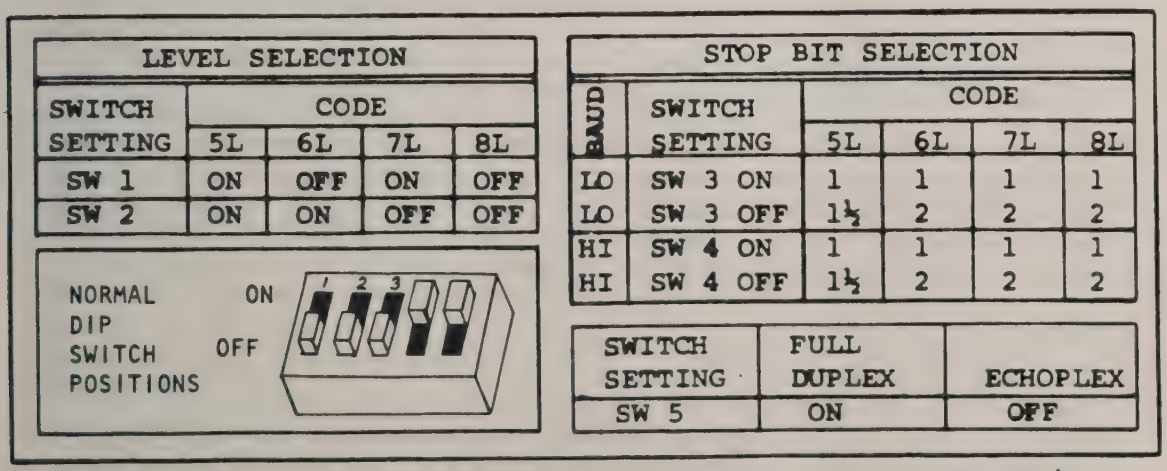
Receiving a character/word is accomplished as follows: the entire word is input to the UART at the RI line, start and stop bits are removed and data bits are held in a register; when DR (data ready) goes high, the character is present as parallel bits at RR1-RR8; parallel data is presented to the punch circuitry as PD1-PD8 (Punch Data bits). After the punch circuitry has accepted a character, the UART receives a PDRR negative pulse which resets the DR line and allows a new character to be converted.

On the parallel input and outputs of the UART are four Tri-State buffers; A11 and B13 are used except when the unit is set for 5 level, then A12 and B14 are used. A12 is used to reverse the data bits RD1-RD5 so that actual level 1 of the tape is transmitted first (the configuration of the reader causes tape level 5 to be read as RD1 and so on to level 1 being read as RD5). B14 shifts the levels (RR1-RR5) out of the UART so that they are in the proper place for punching a 5 level tape.

Figure 4-1 depicts the programming label found on the inside of the cover; refer to it for programming the 901-1951 for 5, 6, 7 or 8 level, 1, 1-1/2, or 2 stop bits or ECHOPLEX operation.

DIP switches SW1 and SW2 control the CLS1 and CLS2 lines (character length select) which in turn control the Tri-State buffers A11, A12, B13, B14 and the UART formation of the transmitted/received character. Reader Data inputs (RD1-RD8) greater than the character length selected are disregarded by the UART. If 5 level were selected, inputs at TR6-TR8 would be ignored and on the output of the UART, parallel bits RR6-RR8 would be held at a logic '0'.

DIP switches SW3 and SW4 control the number of stop bits which will be transmitted by the UART serial output TRO (transmit register out). When left OFF, they select 2 stop bits except for 5 level when the UART generates 1-1/2 stop



Programming Label

Figure 4-1

bits. In the ON position, only 1 stop bit is selected. With the circuitry of A19F and A20 gates, SW3 selects stop bits for LOW baud and SW4 selects stop bits for HIGH baud as controlled by the baud rate switch SW10. At the UART, a logic '0' at SBS (stop bit select) selects 1 stop bit; a logic '1' selects 2 stop bits (1-1/2 for 5 level).

The gates above the UART and IC A18 are for the detection of ASCII control characters DC1-DC4. These control characters are only detected when REM CTL (remote control) SW7 is ON, enabling C22B and 8 level is selected by SW1 and SW2. When a control character is detected, the appropriate signal line goes low and stays low until a new character is converted to parallel by the UART and presented at the RR1-RR8 outputs.

Referring back to the Data Flow Block Diagram, Figure 2-4 (page 2-6), if the 901-1951 is in LINE and FULL duplex modes, the control characters are only detected from data received from the Modem. LOCAL operation allows for detecting control characters generated by either the reader or Printer. With LINE and HALF duplex modes selected, control characters are detected from Printer, reader or Modem.

4.1.4 READER CIRCUITS

The reader circuits are shown on sheets 4 and 5 of the schematic, refer to sheet 4. The top of the schematic shows phototransistor signals from the reader coming into the Logic Card via J2, where A7 and A8 buffer the signals and provide them as parallel data to the UART for transmission. A hole detected by the tape reader is the same as a logic '1' within the 901-1951. Gates A9A, A10A and A5A decode an ASCII carriage return (8 LCR) and enable one shot A4B (when a step pulse is received) which will delay the reading of another character out of the UART until an appropriate time interval which will allow the printer carriages (local and remote) to return and stabilize prior to continued printing. Gates A9B, A10B and A5D decode a 5 level carriage return (5 LCR). VR1, R15, and C10 provide the RC timing network which sets the delay of A4B from 10mSec to 1 Sec.

A signal for detection of the tape sprocket holes is provided at J2-9 where it is buffered by A7C and inverted by B5F. The activity of the reader (ON or OFF) is controlled by Flip-Flop B2A via the present and clear lines. When the reader is on, the Q output of B2A is low; this logical '0' is applied as the D input to B2B and is also used in conjunction with B3B, R19 and C14 to provide pulse steering of the READER RUN CLK to gates A3A and A3B. With the proper gate selected, pressing the reader RUN pushbutton will alternately turn on then off the reader by setting or clearing B2A. Continuous operation of the reader is maintained by the detection of the sprocket pulse. When tape runs out, no sprocket pulse will be generated and the first step pulse will set Flip-Flop B2B to a logical '1', the second step pulse will clock this to B2A's output and the reader will be OFF.

Other circuits may turn the reader on or off; the remote circuit may detect a DC1 or DC3 control characters and start or stop the reader or the EDIT/SKIP circuit may provide RDR START or RDR STOP signals to the reader gating circuit and thereby control the reader control Flip-Flop.

Step action occurs when the following happen; tape is over the phototransistors and B5F provides a low to A1B, no carriage return is detected. A low is at A1B pin 13. The reader is on and A1B pins 11 and 12 are low, A1B then enables B1B.

As long as the 901-1951 has received a CTS from the Modem, B1B is further enabled by the Reader Hold circuit. At the end of transmission of a serial word, TRE goes high from the UART and provides a negative level out of B1B which triggers C4B one shot enables A4B to delay reading another character if a carriage return was detected. C4D is triggered on the falling edge of the C4B pulse and provides a STEP pulse to the reader drive circuit, a preset to error Flip-Flop B2B and an inverted pulse through C2D to load the reader data at RD1-RD8 into the UART. Data is read into the UART before the motor actually starts to move.

Note that POR (power-on-reset) stops the reader initially through B19A and DC3 stops it when in 8 level and remote control operation.

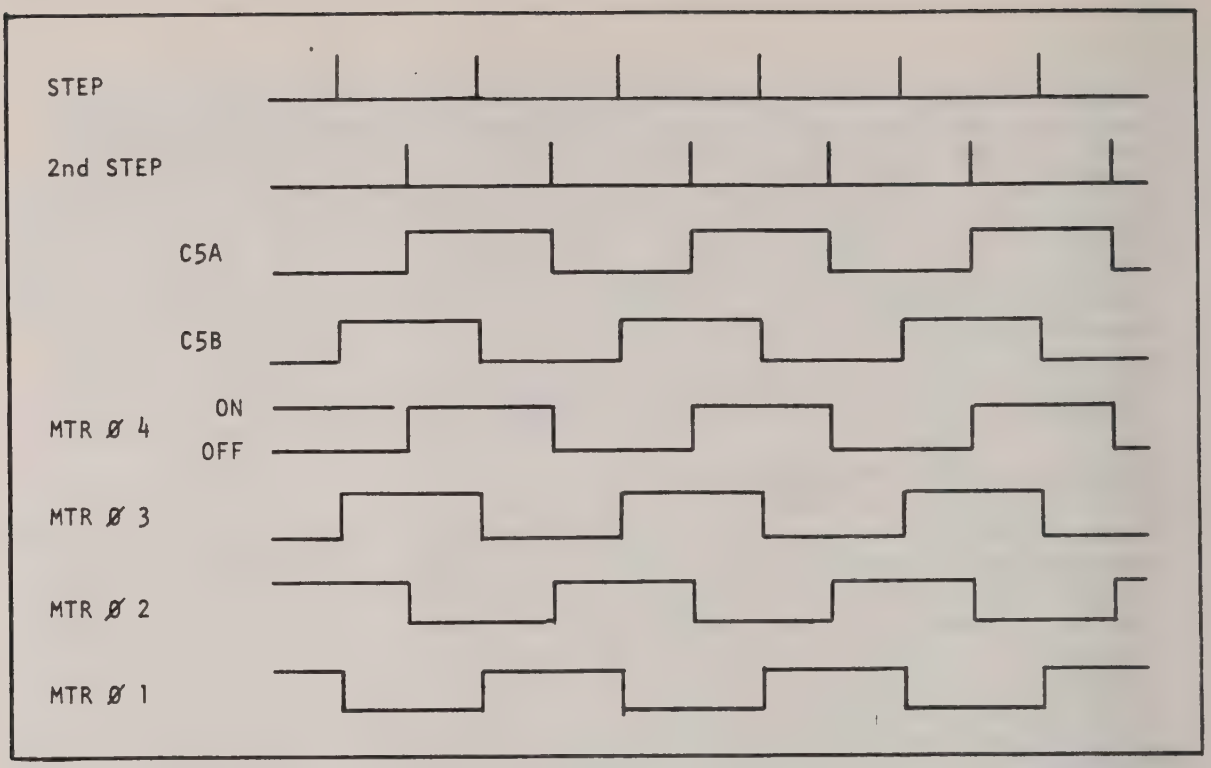
4.1.4.1 EDIT/SKIP CIRCUITS

Refer to sheet 5 of the schematic. The negative STEP pulse is inverted through B1A and clocks Flip-Flops C5B and C5A simultaneously. Figure 4-2 shows the results of this stepping action by depicting the on states of the motor phases. The reader stepping motor is a 4 phase motor used in dual phase mode, that is, the motor is driven by sequentially energizing two adjacent windings at a time. Since the reader motor is a 7-1/2° stepping motor, two steps are needed to move the tape one character or 15°. POR initially clears C5A and C5B. A STEP pulse is received which causes one or the other Flip-Flops to change state and B3D goes low. The AC coupling of C27 and R38 trigger timer C1 which provides a delayed second step. This moves the stepping motor an additional 7-1/2° to align the next character over the read station (phototransistors).

Turning on the reader provides a READER ACTIVE high signal to the base of Q1 which discharges C31 and holds timer C3 from timing out. Simultaneously, $\overline{\text{READER ACTIVE}}$ low holds C3 output high thereby enabling the RUN LED and turns on Q2 providing power for the reader infrared LED's and biasing on Boost Driver Q3 which will then raise the stepping motor from the standby +12V to the drive +24V. When the reader is off, the drive voltage is lowered to 12V to reduce dissipation by the motor.

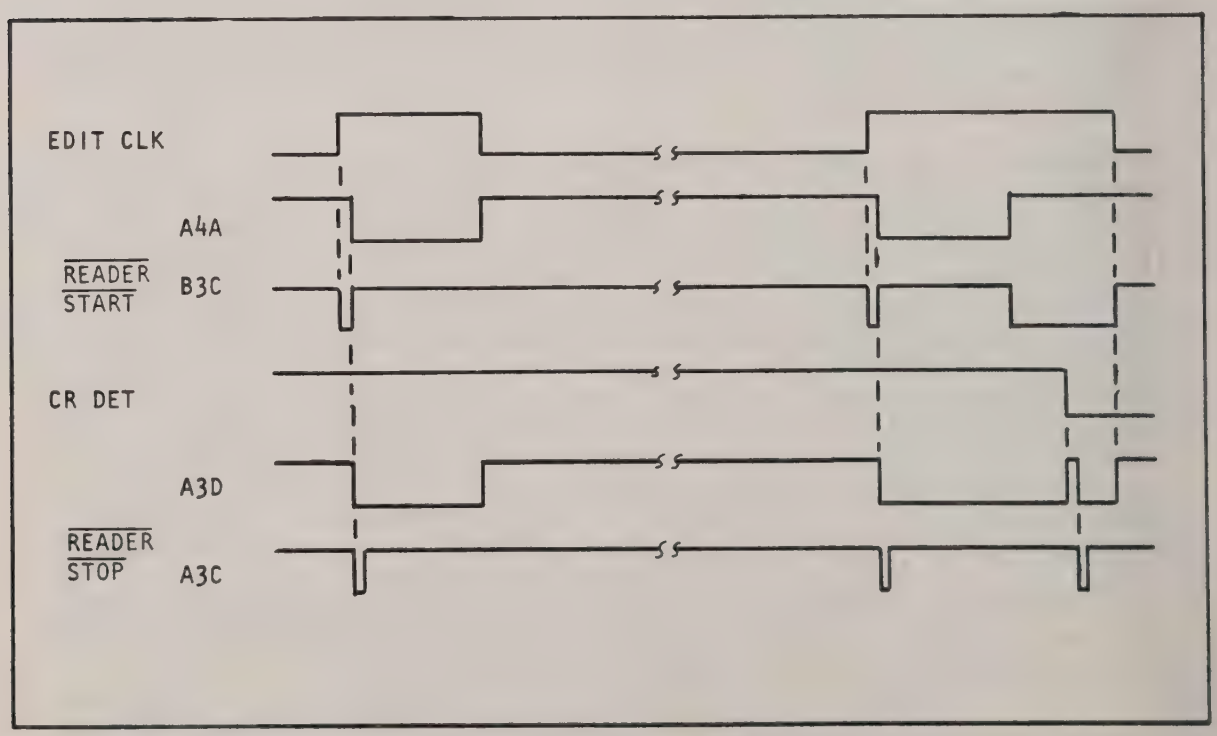
At the top of the schematic is the EDIT/SKIP Control circuitry. When the EDIT pushbutton is pressed, it starts the reader and stops it after one character advance of the tape. Figure 4-3 shows the timing for the EDIT functions. The first half of the waveform shows what occurs when the EDIT pushbutton is momentarily depressed. Because R35 and C24 delay the Edit Clock high from B3C initiating one shot A4A, a short negative $\overline{\text{RDR START}}$ pulse is generated from A3C which starts or turns on the reader. The one shot time delay is set for approximately 1/2 second but the release of the EDIT pushbutton will cause the one shot to be cleared. The Edit Clock will cause a low out of A3D which is slightly delayed by R37 and C26 and coupled to exclusive OR gate B3C. This delay action causes a short low pulse out of B3C ($\overline{\text{RDR STOP}}$) which comes after the start pulse because of the delaying action of R35 and C34. Therefore, a single start and stop are generated in order to advance the reader one character.

The second half of the waveforms shows the results of holding the EDIT pushbutton. A start and stop are generated but because the pushbutton is held, the one shot times out, generates and holds another low start level until



Reader Stepping Motor Timing

Figure 4-2



Edit Control Timing

Figure 4-3

release of the pushbutton clears the one shot. When a CR is detected by the reader, A3D goes high and because the EDIT switch is held, exclusive OR gate B3C generates another low $\overline{\text{RDR STOP}}$ pulse which haults the reader. In order for the Edit function to be used again, the pushbutton must be released and then pressed again.

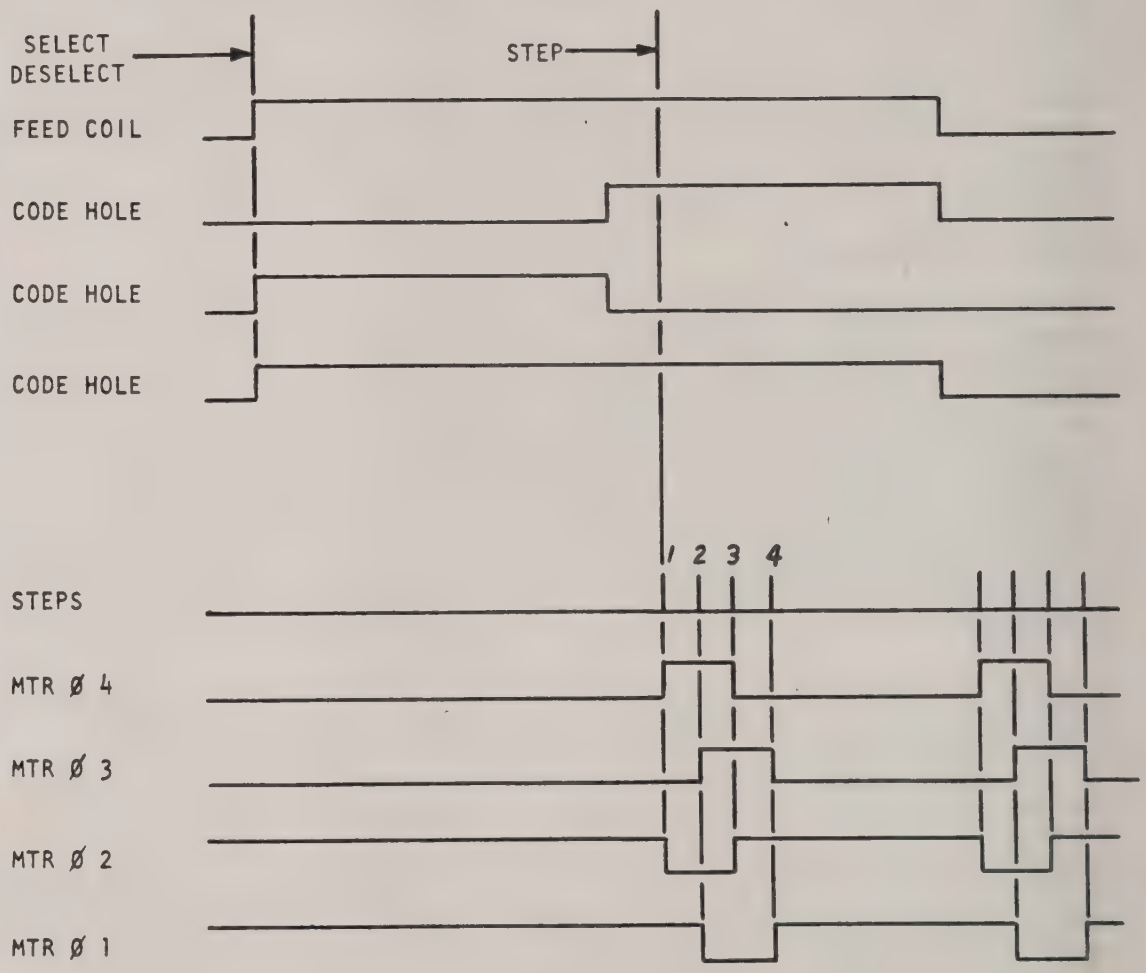
The SKIP circuit works the same as the EDIT circuit but it doesn't allow any data to be transmitted. This is accomplished by a logic '0' on the DISABLE line which will not allow the STEP signal to load the UART via the TBRL line. DISABLE is generated for as long as the SKIP pushbutton is held plus an appropriate delay as created by one shot C4C and gate B4A.

4.1.5 PUNCH CIRCUITS

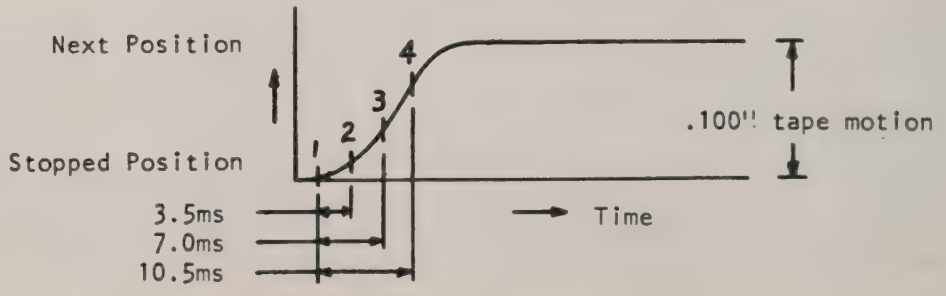
The circuitry for the punch is shown on sheets 6-9 of the schematic, refer to sheet 6. The Moduperf punch mechanism is a synchronous device which operates on the punch-feed principle. If no command to punch is given, the tape remains motionless, the punch pins are not driven into the paper, but the drive motor continues to turn. To punch a character, the selector coils are energized and the tape is perforated during the cycle; the tape will advance one character the next cycle. If a second character is to be punched during the second cycle, the selector coils are energized while the tape is advancing as a result of the previously punched character. When the last character of a block of data has been punched, a final tape advance will occur in the next machine cycle and the last character punched will be seen at the edge of the die block.

The timing diagram of Figure 4-4 shows the action of the selecting module and stepping motor. The feed track and 3 code levels are shown; 2 code levels show a single hole punch and the other shows 2 consecutive holes punched. Note the 1 character delay from selection (and Punch) to stepping motor activity. The main function of most of the punch electronics is to synchronize the processing (punching) of data to the machine cycle of the Moduperf drive mechanism. This is accomplished by magnetic pulses which are created because the fingers of a timing wheel pass close to a pickup coil mounted over a permanent magnet and induce a voltage in the coil. The waveform of the MPU coil is somewhat sinusodial with a positive then negative excursion with sufficient amplitude to drive D9. Diode CR9 eliminates the entire negative excursion and the negative going edge of the positive excursion is what triggers D9. Referring to Figure 4-5, punch timing waveforms are depicted for several cycles of machine time. All waveforms start as if we powered up the unit with the drive assembly just passing the sixth finger.

When no MPU pulses are detected for a specified period, timer D8 times out and clears the pulse counters to await the beginning of a new machine cycle. Two outputs are used out of D9, pin 7 is the charge and discharge of C32 while pin 3 is a pulse string mirroring the MPU pulses themselves. D9 is used to square up the pulses while D8 is the missing pulse detector (MPD). Flip-Flop D18B and D18A are cleared by the MPD. When the first MPU pulse comes through D9, D18B toggles and enables D18A so that the second MPU pulse will toggle D18A. If the UART has data ready for punching, PDR will be high and the transistion of D18B going high will clock a high to the D input of Flip-Flop C19A. When the

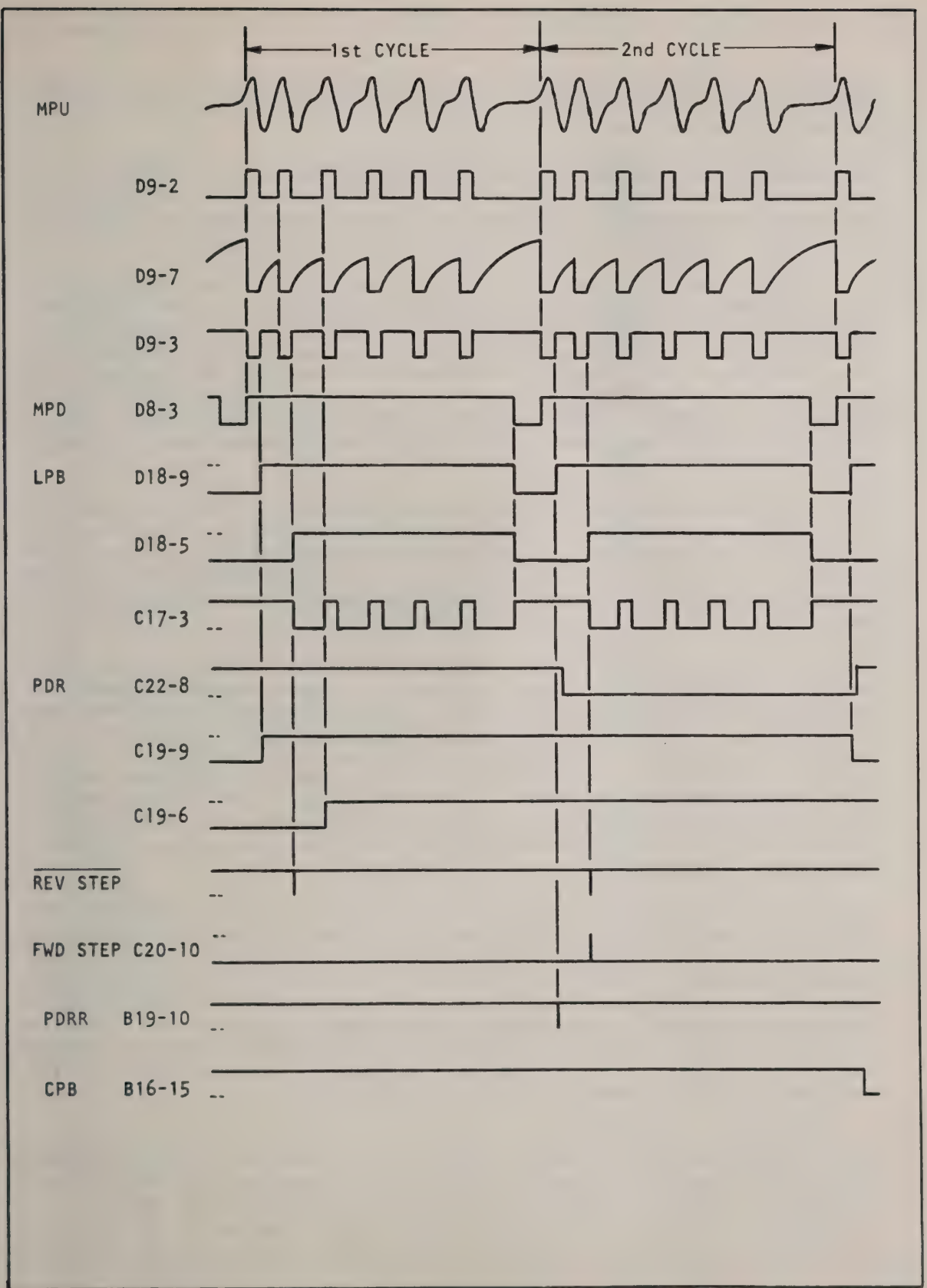


Stepper Motor Motion - 4 Steps of Motor moves the tape by one character (.100")



Punch Stepping Motor Timing

Figure 4-4



Punch Timing

Figure 4-5

third MPU pulse is present, C19A toggles and enables the gate C20B. Since REV STEP has already taken place (second MPU pulse) no forward step is initiated for the first machine cycle.

POR presets Flip-Flop A17B to an ON condition (PUNCH on). The logic 1 from the Q output provides a signal to light the LED on the PUNCH pushbutton switch and also enables C22C and the PDR (punch-data-ready) flag from the UART. A17B is toggled on and off when the PUNCH on pushbutton is activated.

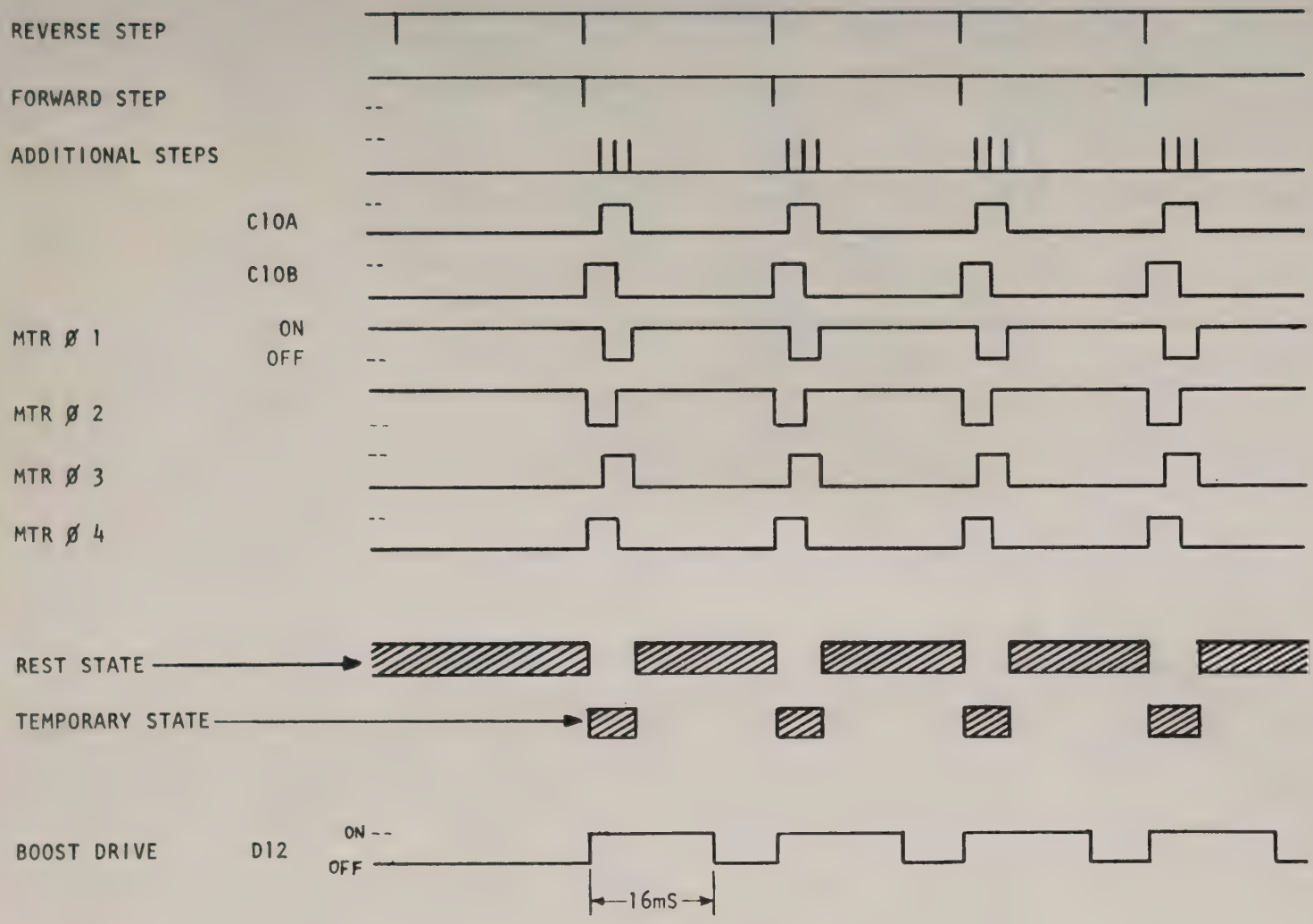
When the UART has converted serial data to parallel, PDR goes high, this high will be transfered to the outputs of Flip-Flops B12A and C19B at the end of the first MPU pulse. A high out of B12A will disable a CPB (clear punch buffer) from occurring. A high from C19B Q side will allow C19A to toggle on the third MPU pulse. At the end of the first MPU pulse, LPB goes high and loads data into the buffer where selector coil drivers are then actuated, simultaneously, a low going PDRR pulse will be generated if PDR was high. This PDRR acts to data ready reset the UART and allow for conversion of a new serial character.

When the FEED pushbutton is pressed, Flip-Flop C19A will have a constant high as an input which will turn on the feed coil driver C19A and allow for FWD (forward) STEP's to advance the tape (punching the feed hole) as long as the switch is held. The FEED should not be activated when data is being punched because activating FEED causes the CPB signal to hold clear the punch buffers and override any data presented from the UART.

Refer to schematic sheet 7, the punch stepping motor is controlled by FWD STEP, REV STEP and BACK SPACE. Figure 4-6 shows the normal sequence of operation for forward stepping of the motor while Figure 4-7 shows the BACK SPACE mode of operation. The stepping motor operates with two phases always on. Tape is advanced one character (0.1") when the motor has taken four steps. Thus, there is only 1 rest state associated with the stepping motor; phase 1 and 2 on. From the time the stepping motor is commanded to step from its rest position, it must take a total of four steps and then dampen out all motion within 16mSec. This is accomplished by applying three additional steps after the first step. (See motion diagram in Figure 4-4)

Stepping motor coil resistance is nominally 5ohms per coil, therefore a two level drive voltage is required to reduce the power dissipated in the motor via R63. In the normal mode of operation, a FWD STEP comes from the timing circuitry (schematic sheet 6), immediately fires the D12A timer to provide Boost Drive via Q4, then clocks Flip-Flops C10A and C10B. The timing waveforms show states of the Flip-Flops after successive step pulses. Note that the first FWD STEP is missing because of the 'punch-feed' operation. Approximately 16mSec. after a FWD STEP pulse, the Boost Drive timer D12A turns off Q4 and stepping motor common reverts to the detent voltage.

The Back Space circuitry at the top of the schematic is designed so that a tape may be backed up and then overpunched. In order to ensure the proper hole registration and spacing, the backing up of one character involves moving the tape backwards two characters and then forward one character. There is no limitation to the number of characters which may be backed up, so long as proper tape handling is provided. During the backspace operation, no selector



Punch Forward Step Operation

Figure 4-6

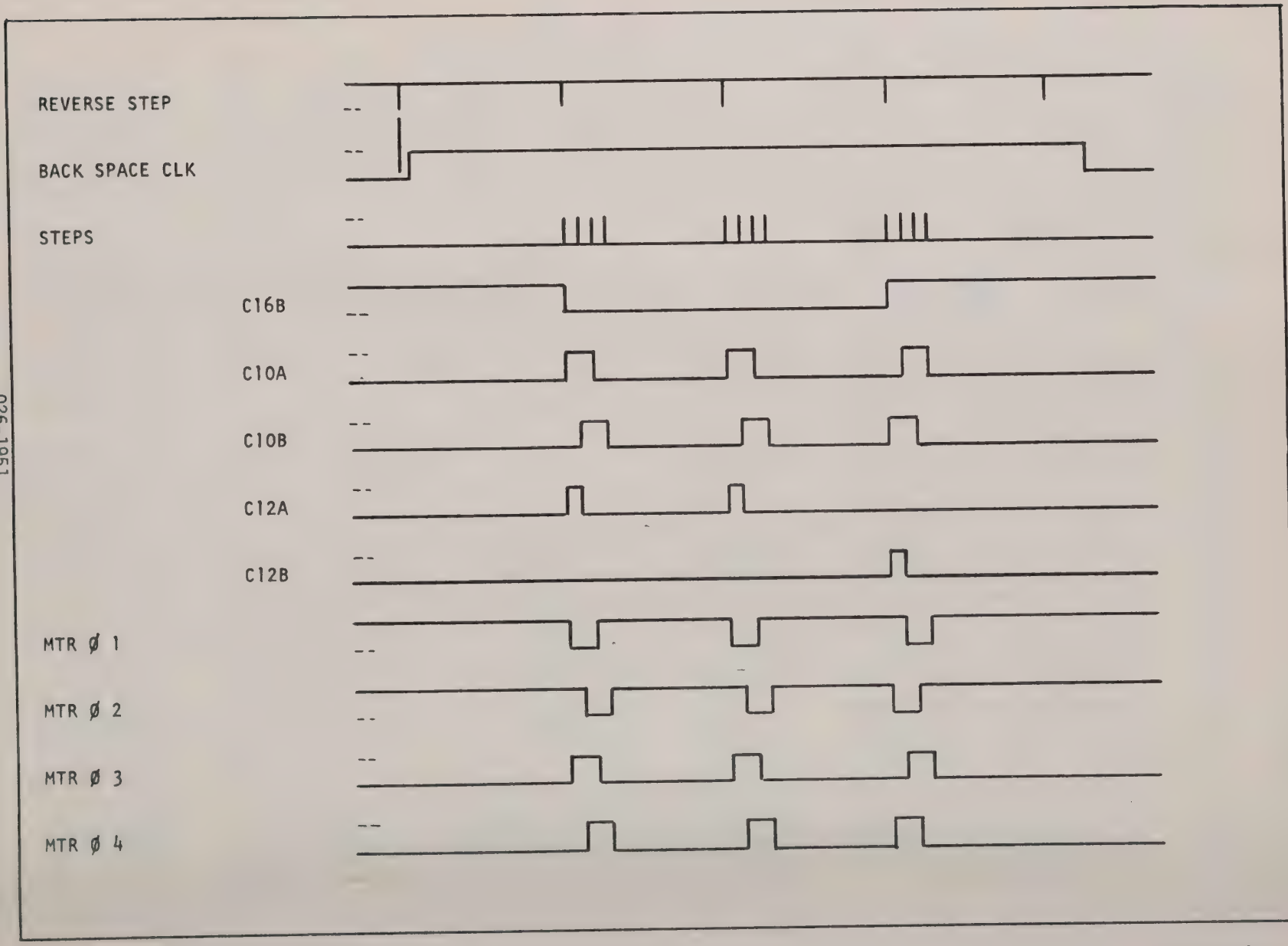

REVERSE STEP
BACK SPACE CLK
STEPS
C16B
C10A
C10B
C12A
C12B
MTR Ø 1
MTR Ø 2
MTR Ø 3
MTR Ø 4

Figure 4-7

selenoids are energized. Figure 4-7 shows the initiation of the backspace operation. FWD STEP's are not generated so the stepping action comes from the REV STEP pulse which is gated through to the stepping motor logic because C14A has been toggled. Before the REV STEP pulse can get to the Flip-Flops, it is enabled through D16D, clocks C14B which causes the exclusive OR gates C11C and C11D to have one input change to a low. When REV STEP pulse comes to the Flip-Flops, the logic reversal will cause the motor to step backwards. This backward stepping occurs for two REV STEP pulses and upon the third REV STEP pulse, the back space circuitry clears itself (D10A) and sets up the drive logic for normal forward stepping. Phase control is provided from the Flip-Flops through inverters and to transistors Q6-Q9 which drive the motor phases. POR initially clears the Flip-Flops and the back space circuit. Figure 4-8 shows typical stepping motor drive transistor voltage waveforms.

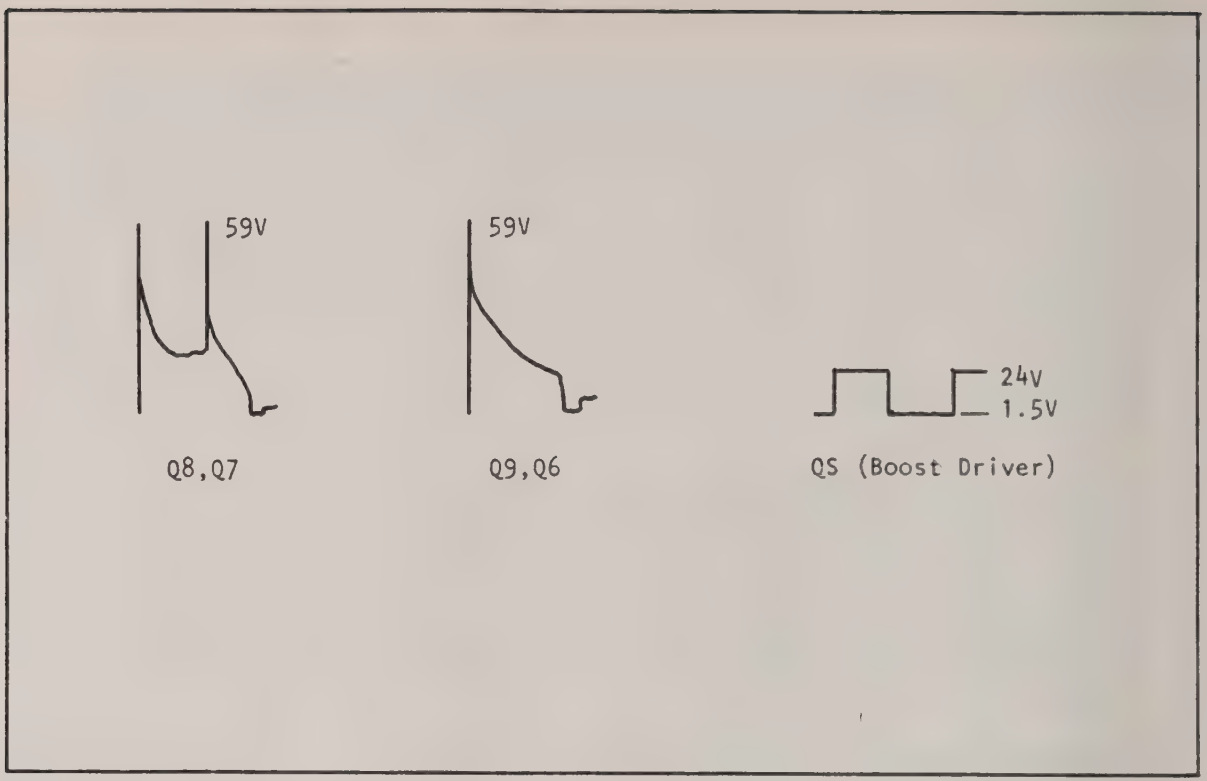
The top of sheet 8 shows the additional step generating circuit. The phase Flip-Flops C10A and C10B provide 01-04 data while back space Flip-Flop C14A provides REV and FWD direction controls to gates C12A and C12B. These gates correctly trigger the start of additional steps, from either normal or BACK SPace operation. The output of C13A going low triggers the D12 delay timers. An additional step is generated by the D14 pulse timers upon the falling edge of the delay timer signal. Therefore, an additional step will be generated at 3.5mS, 7.0mS, and 10.5mS after a FWD or REV STEP.

The bottom of sheet 8 shows the Baud Rate timer circuit. Two timers are used, one for HIGH and one for LOW Baud Switch positions. Pin 4 of the appropriate timer is enabled by the Baud Switch; D22 for HIGH and D21 for LOW. Timer frequencies are twice that required by the UART, so they are divided in half and made symmetrical by A17A.

Sheet 9 of the schematic shows the selector module drive circuitry. Parallel data from the UART is clocked into the buffers B12 and B11 by LBP (Load Punch Buffer), where it provides the logic to drivers B9 and B10 to select the correct level to be punched. CPB (Clear Punch Buffer) clears the buffers of data after no new parallel data is available from the UART. This deenergizes the selector selinoids. If a FEED function is initiated, only feed holes (not data levels) will be punched. Note that the FEED DRIVER is not buffered but derives its signal from the feed latch C19B (sheet 6 of the schematic). Figure 4-9 shows the typical waveform as obtained across any of the drivers.

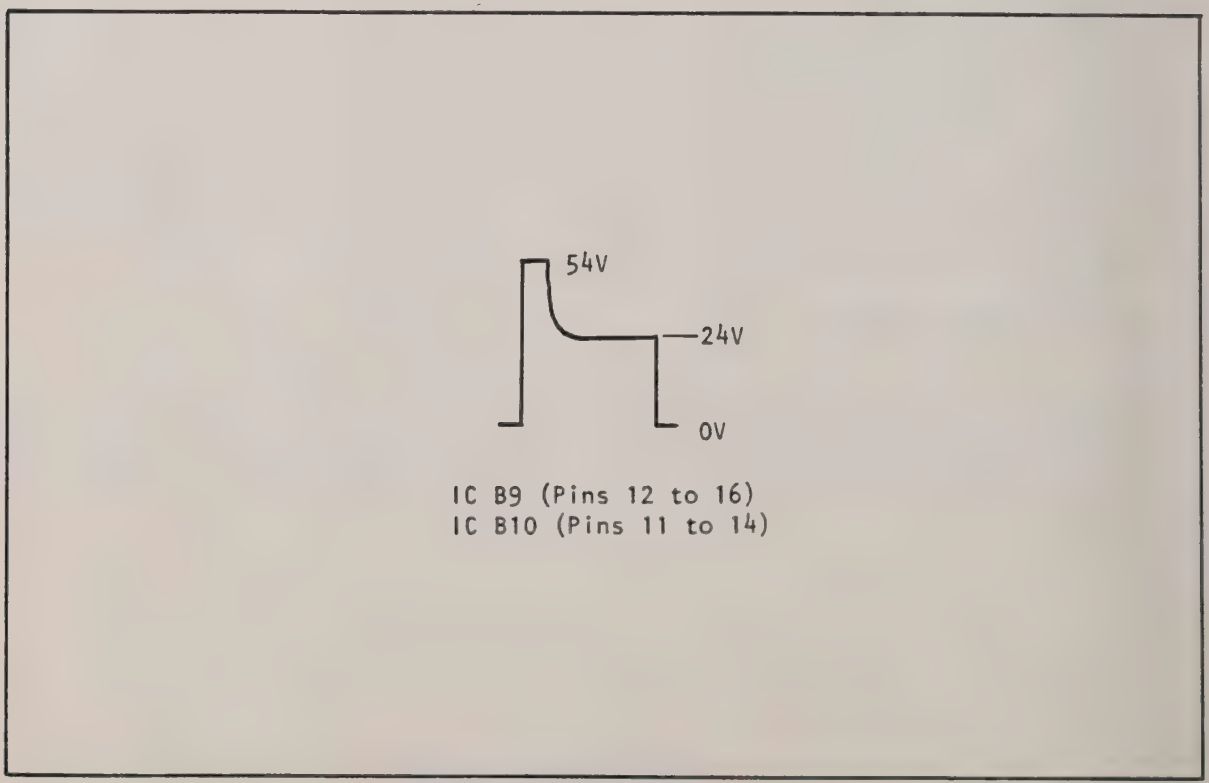
4.2 ASSEMBLY DRAWING

The issue number of the Logic Card Assembly is located along the center bottom edge of the board (Assy 8846 ISS□). Issues 1 & 2 cards are shown in Figure 4-10 while Issues 3 & up cards are shown in Figure 4-10a. Note the Issue number of the Logic Card in your unit and refer to the appropriate figure to locate components.



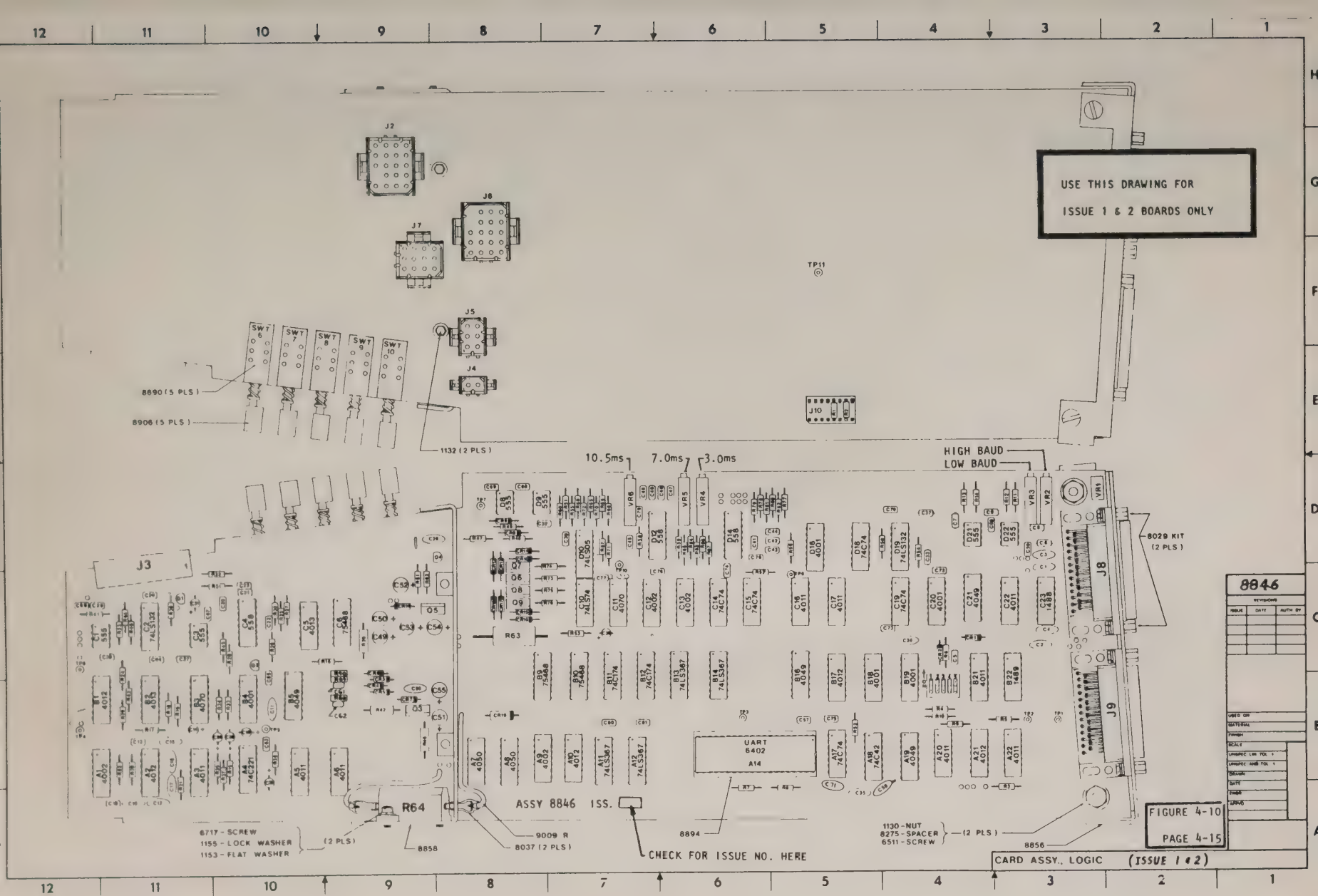
Punch Stepping Motor Driver Waveforms

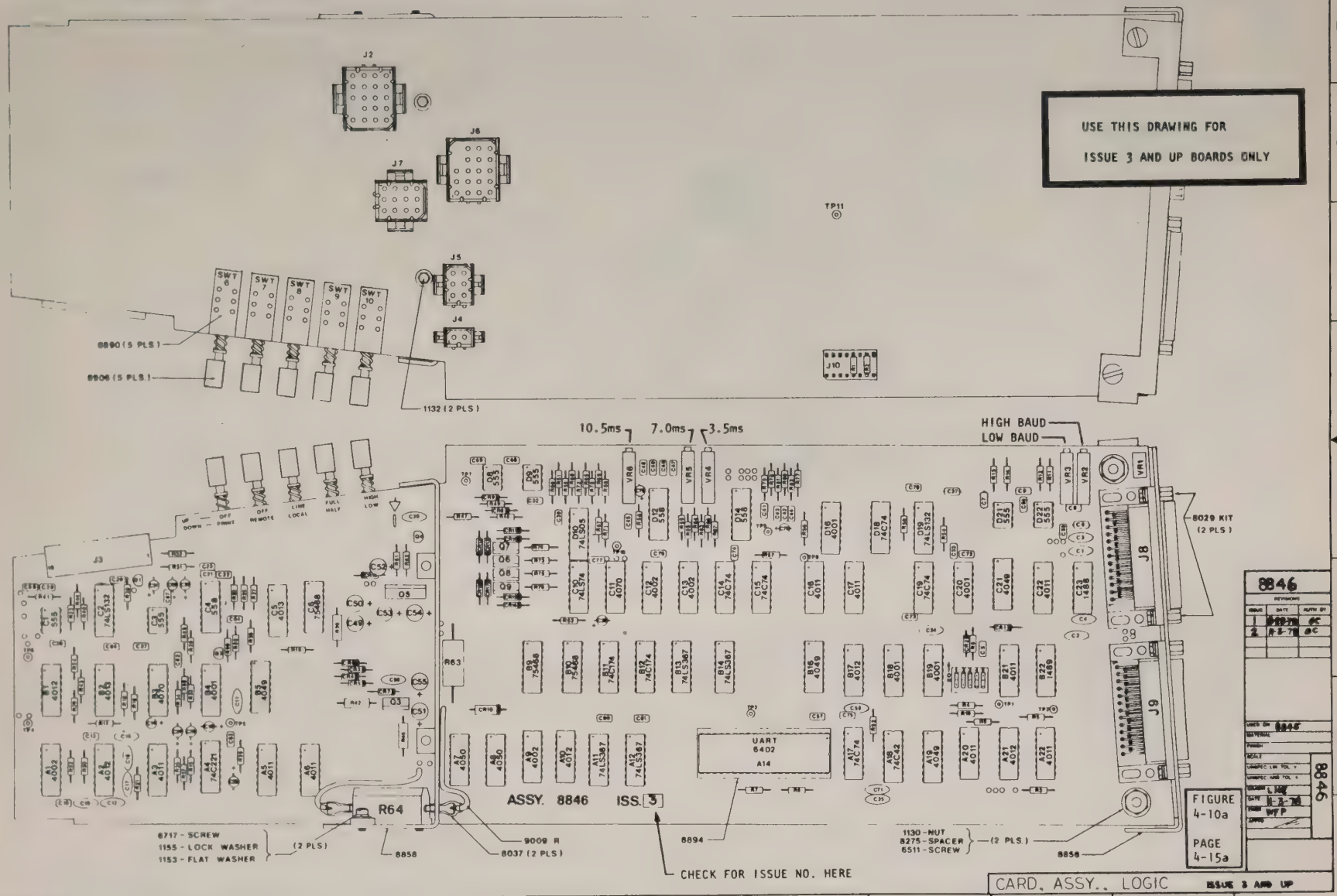
Figure 4-8

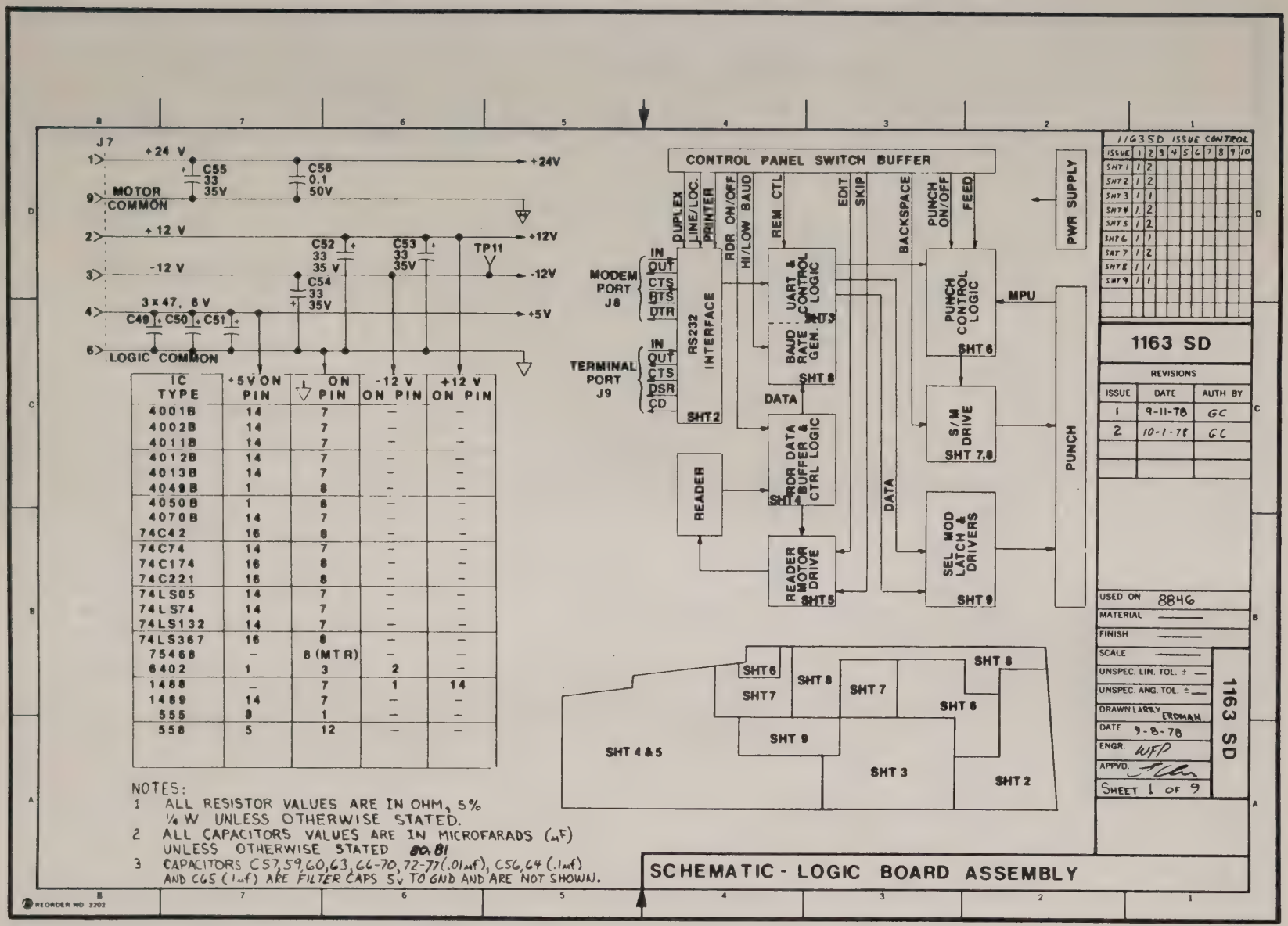


Selector Module Driver Waveforms

Figure 4-9


USE THIS DRAWING FOR
ISSUE 1 & 2 BOARDS ONLY
J2
J6
J7
J5
J4
J10
TP11
SWT 6
SWT 7
SWT 8
SWT 9
SWT 10
8890 (5 PLS)
8906 (5 PLS)
1132 (2 PLS)
10.5ms
7.0ms
3.0ms
HIGH BAUD
LOW BAUD
VR1
VR2
VR3
VR4
VR5
VR6
8029 KIT
(2 PLS)
J3
J8
J9
R63
R64
UART
8402
A14
ASSY 8846 ISS.
6717 - SCREW
1155 - LOCK WASHER
1153 - FLAT WASHER
(2 PLS)
8858
9009 R
8037 (2 PLS)
CHECK FOR ISSUE NO. HERE
8894
1130 - NUT
8275 - SPACER
6511 - SCREW
(2 PLS)
8856
8846
FIGURE 4-10
PAGE 4-15
CARD ASSY., LOGIC (ISSUE 1 & 2)


USE THIS DRAWING FOR
ISSUE 3 AND UP BOARDS ONLY
J2
J6
J7
J5
J4
J10
TP11
SWT
8890 (5 PLS.)
8906 (5 PLS.)
1132 (2 PLS.)
10.5ms
7.0ms
3.5ms
HIGH BAUD
LOW BAUD
8029 KIT
(2 PLS.)
J3
J8
J9
UART
6402
A14
R64
ASSY. 8846 ISS. 3
CHECK FOR ISSUE NO. HERE
6717 - SCREW
1155 - LOCK WASHER
1153 - FLAT WASHER
(2 PLS.)
8858
9009 R
8037 (2 PLS.)
8894
1130 - NUT
8275 - SPACER
6511 - SCREW
(2 PLS.)
8856
8846
FIGURE
4-10a
PAGE
4-15a
CARD, ASSY., LOGIC
ISSUE 3 AND UP



IC TYPE	+5V ON PIN	⏚ ON PIN	-12 V ON PIN	+12 V ON PIN
4001B	14	7	–	–
4002B	14	7	–	–
4011B	14	7	–	–
4012B	14	7	–	–
4013B	14	7	–	–
4049B	1	8	–	–
4050B	1	8	–	–
4070B	14	7	–	–
74C42	16	8	–	–
74C74	14	7	–	–
74C174	16	8	–	–
74C221	16	8	–	–
74LS05	14	7	–	–
74LS74	14	7	–	–
74LS132	14	7	–	–
74LS367	16	8	–	–
75468	–	8 (MTR)	–	–
8402	1	3	2	–
1488	–	7	1	14
1489	14	7	–	–
555	8	1	–	–
558	5	12	–	–

NOTES:
1 ALL RESISTOR VALUES ARE IN OHM, 5% ¼ W UNLESS OTHERWISE STATED.
2 ALL CAPACITORS VALUES ARE IN MICROFARADS (μF) UNLESS OTHERWISE STATED 80.81
3 CAPACITORS C57,59,60,63,66-70,72-77(.01μf), C56,64 (.1μf) AND C65 (1μf) ARE FILTER CAPS 5v TO GND AND ARE NOT SHOWN.

1163SD ISSUE CONTROL

ISSUE	1	2	3	4	5	6	7	8	9	10
SHT 1	1	2								
SHT 2	1	2								
SHT 3	1	1								
SHT 4	1	2								
SHT 5	1	2								
SHT 6	1	1								
SHT 7	1	2								
SHT 8	1	1								
SHT 9	1	1								

1163 SD

REVISIONS

ISSUE	DATE	AUTH BY
1	9-11-78	GC
2	10-1-78	GC

USED ON 8846
MATERIAL
FINISH
SCALE
UNSPEC. LIN. TOL. ±
UNSPEC. ANG. TOL. ±
DRAWN LARRY EROMAN
DATE 9-8-78
ENGR. WFP
APPVD.
SHEET 1 OF 9

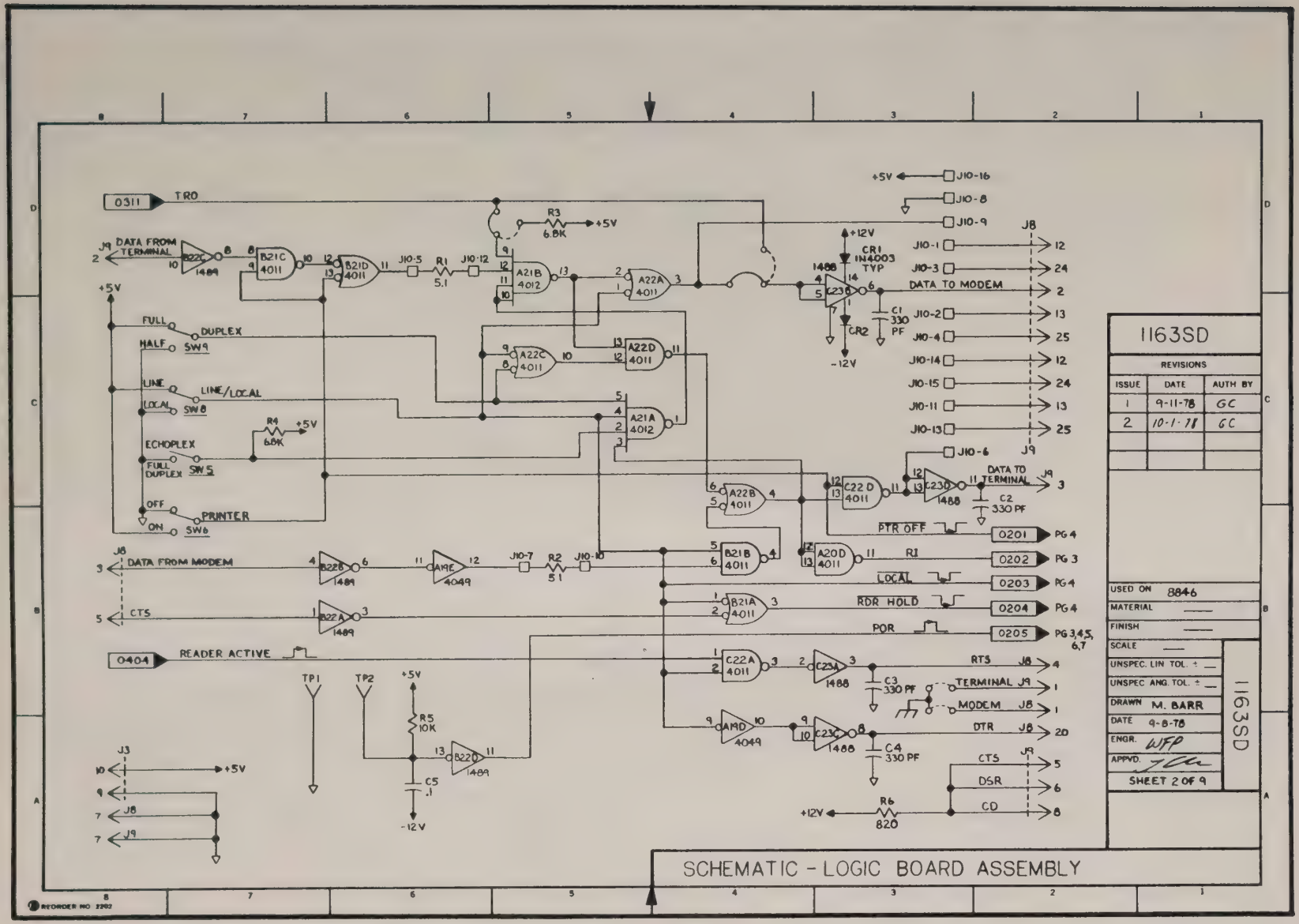
1163 SD

SCHEMATIC - LOGIC BOARD ASSEMBLY

REORDER NO 2202

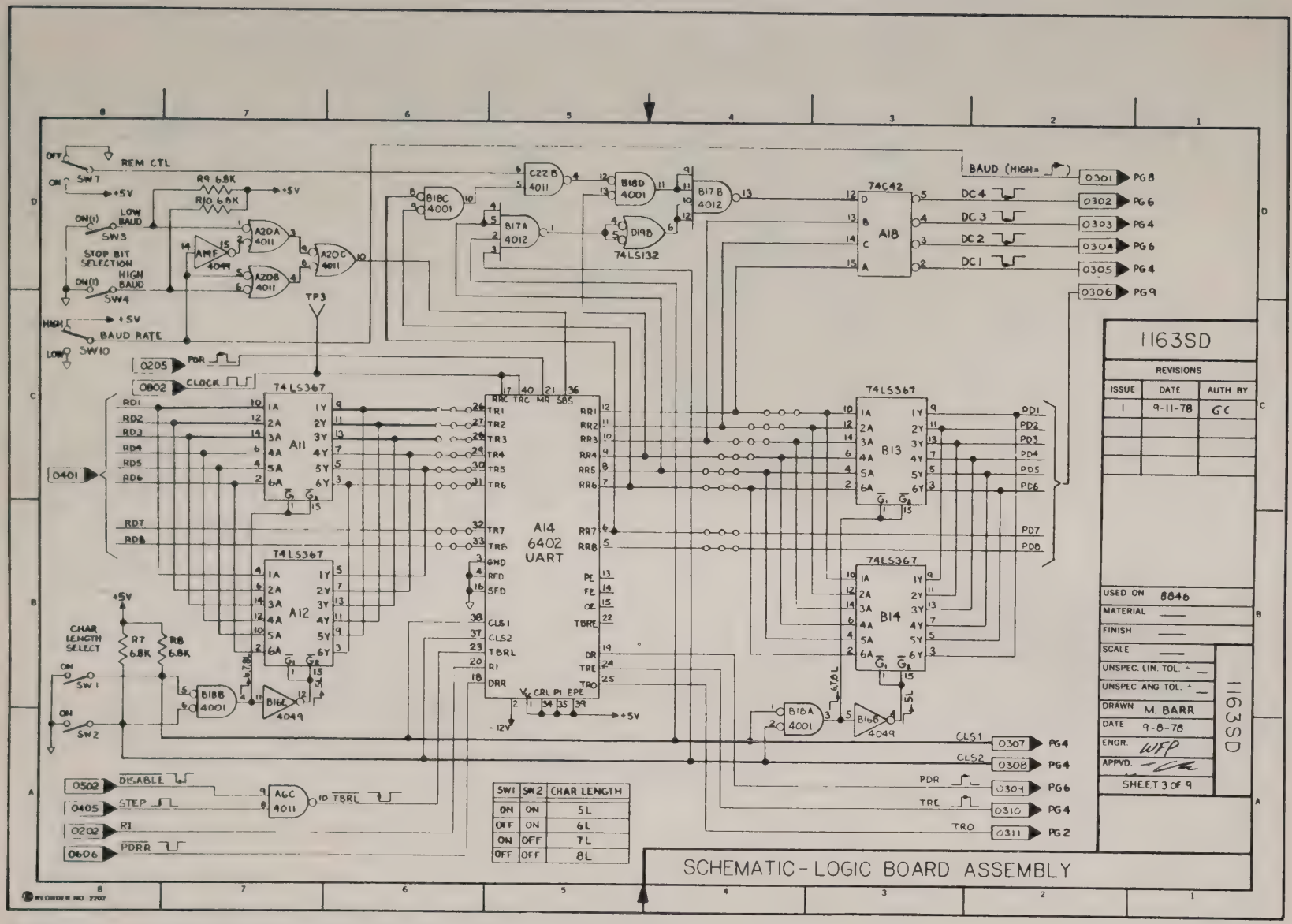
Schematic - Logic Board Assembly, Block Diagram

Figure 4-11a



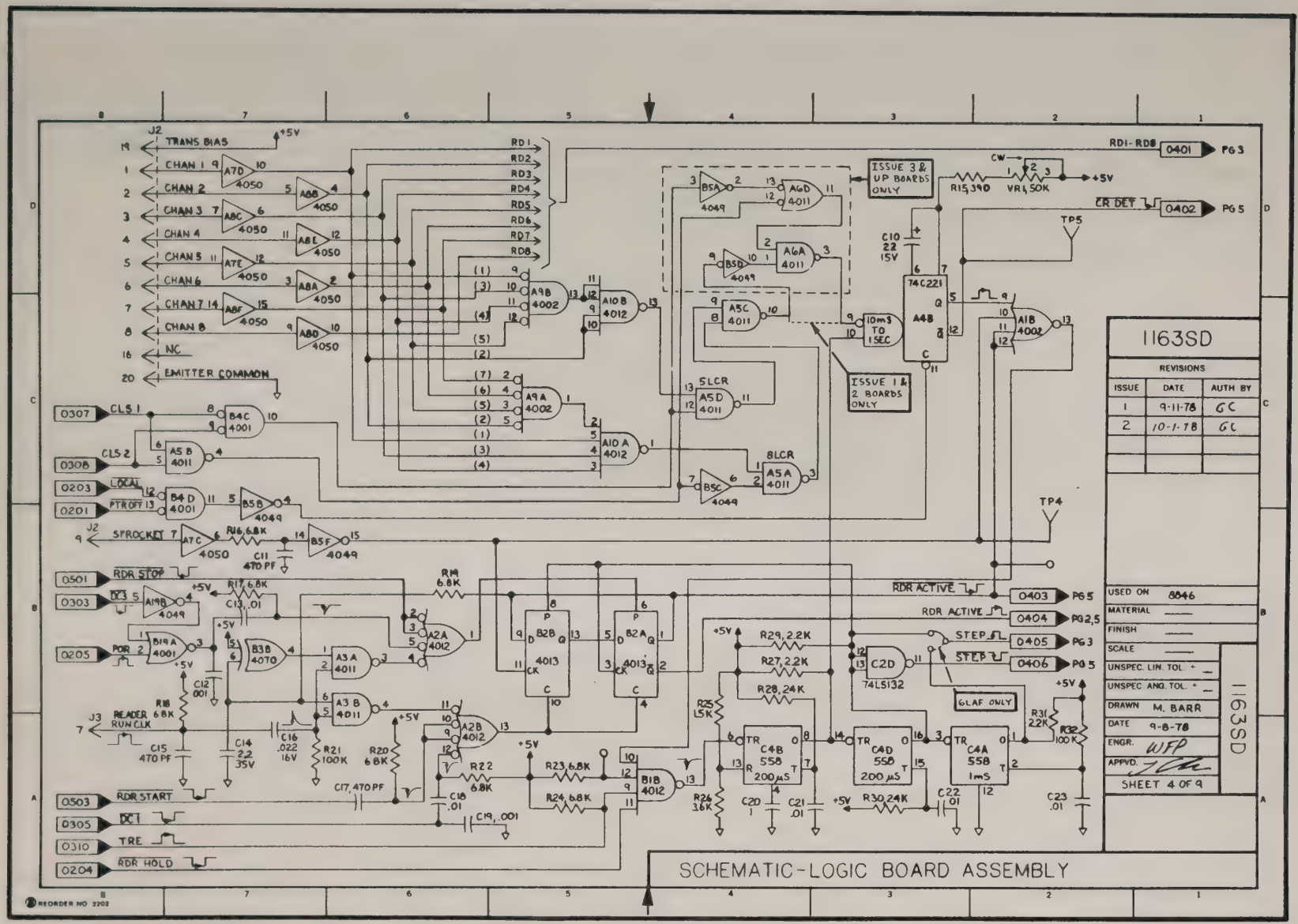
Schematic - Logic Board Assembly, RS-232 Interface

Figure 4-11b



Schematic - Logic Board Assembly, UART & Control Logic

Figure 4-11c



Schematic - Logic Board Assembly, Reader Data Buffer and Control Logic

Figure 4-11d

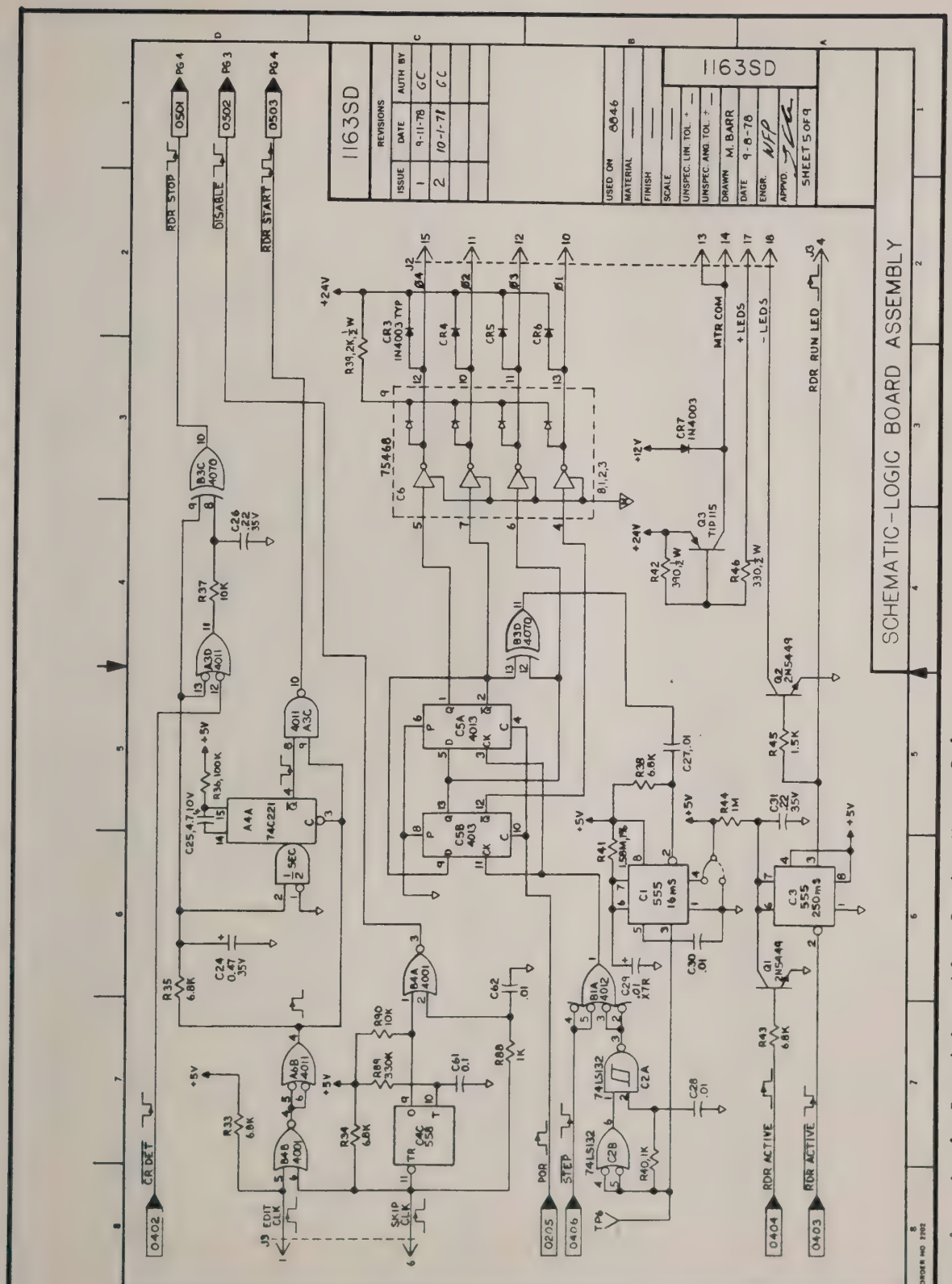
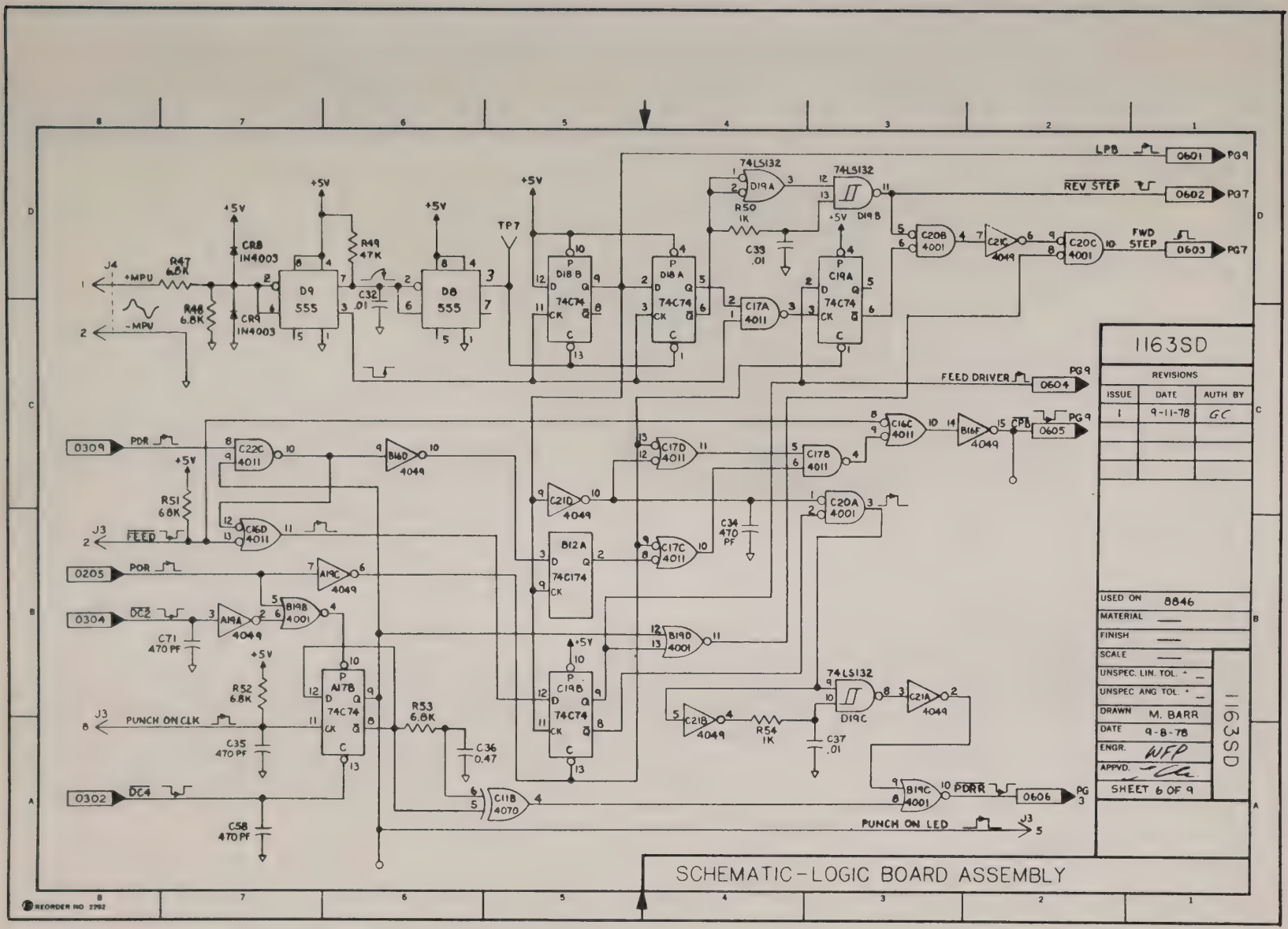


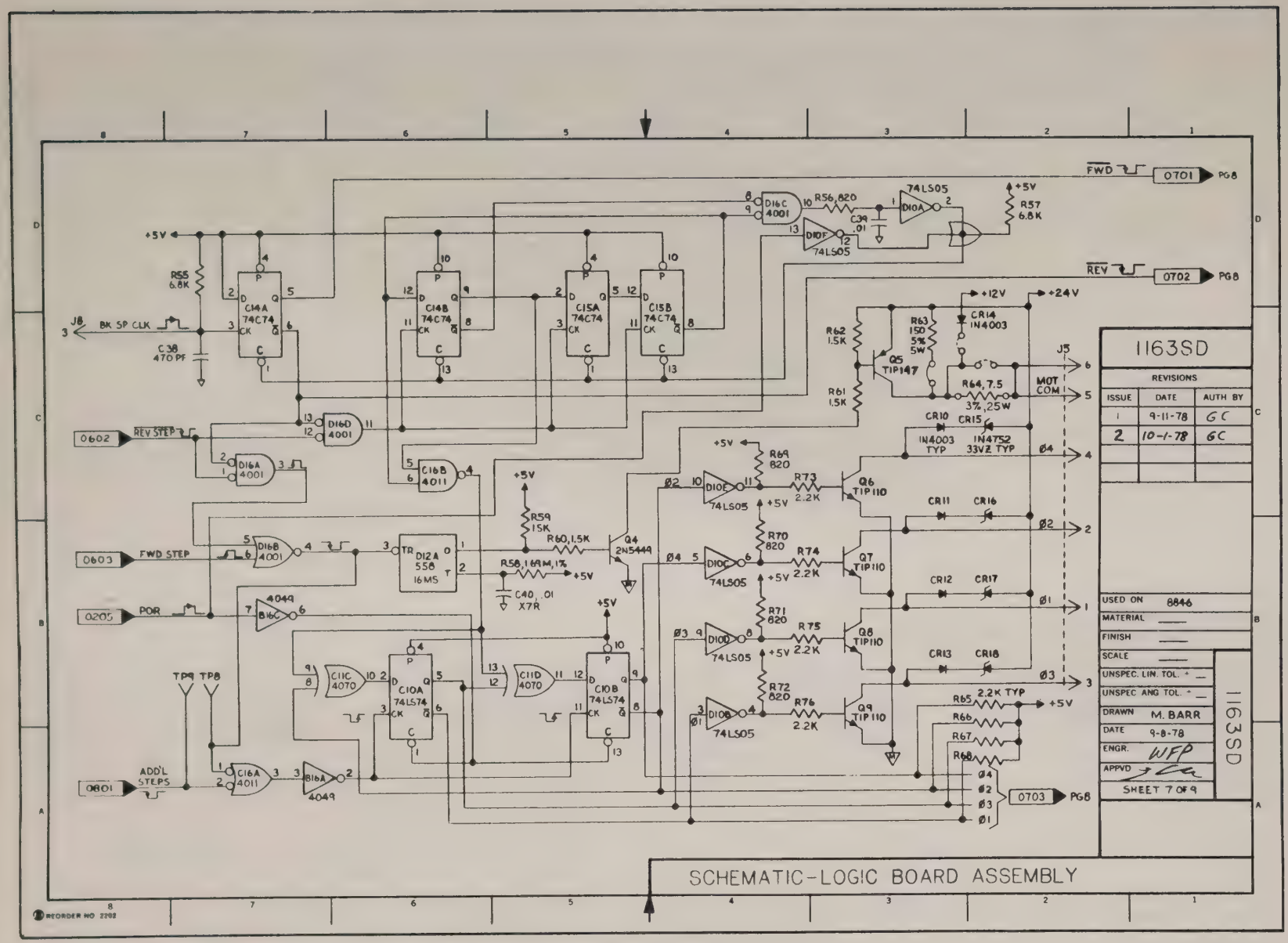
Figure 4-11e

Schematic - Logic Board Assembly, Reader Motor Drive



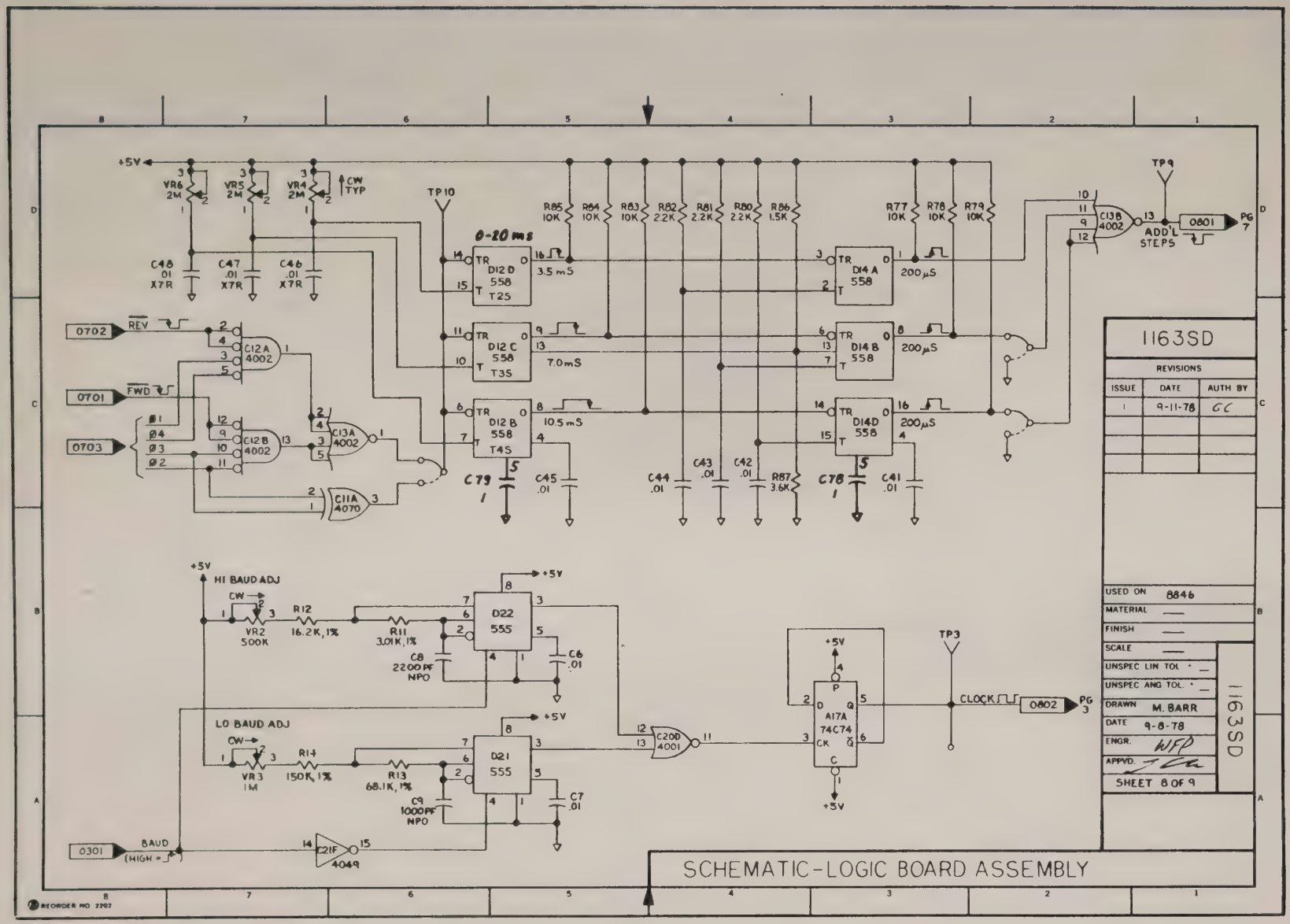
Schematic - Logic Board Assembly , Punch Control Logic

Figure 4-11f



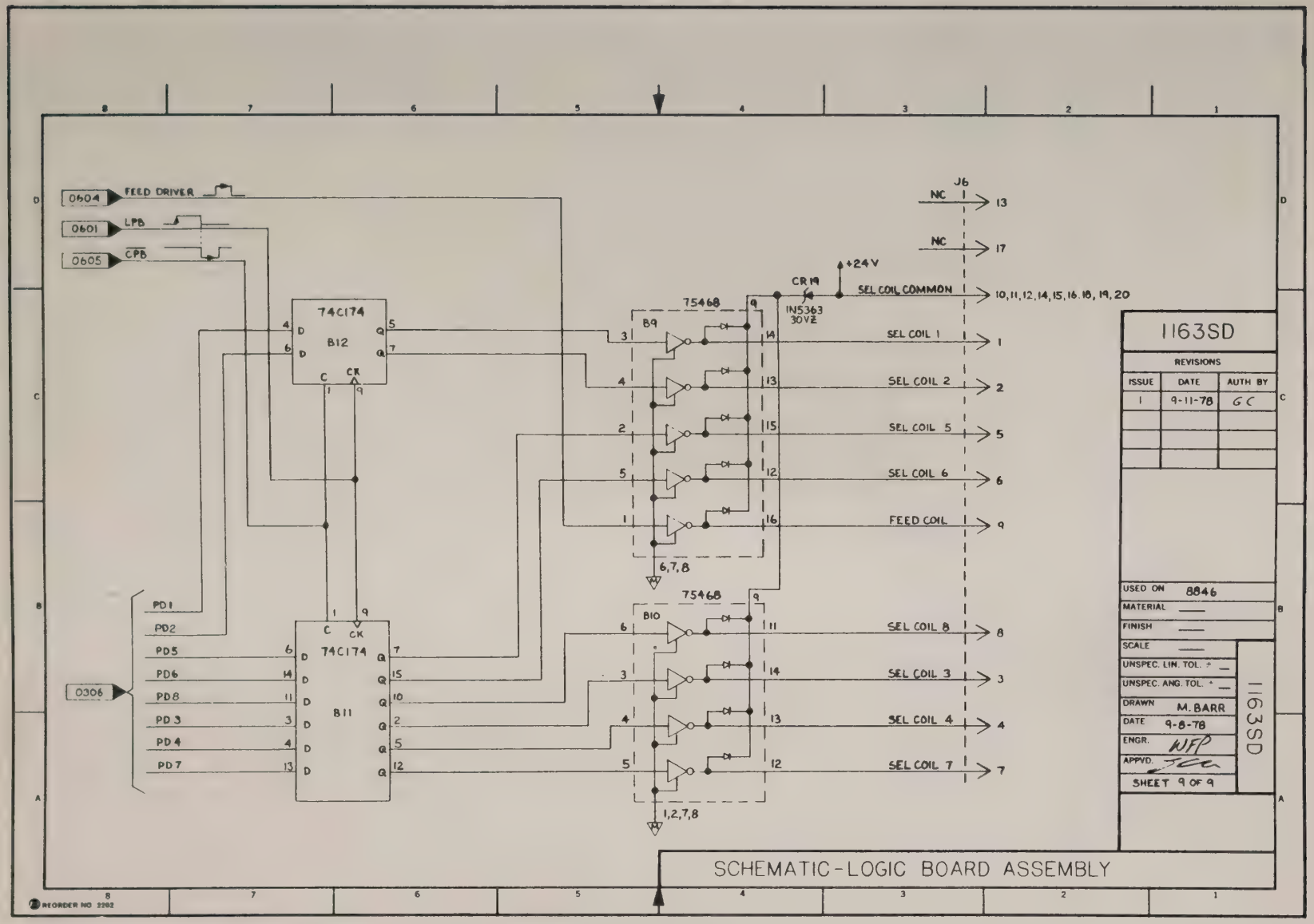
Schematic - Logic Board Assembly, Stepping Motor Drive

Figure 4-11g



Schematic - Logic Board Assembly, Stepping Motor Drive/Baud Rate Generator

Figure 4-11h



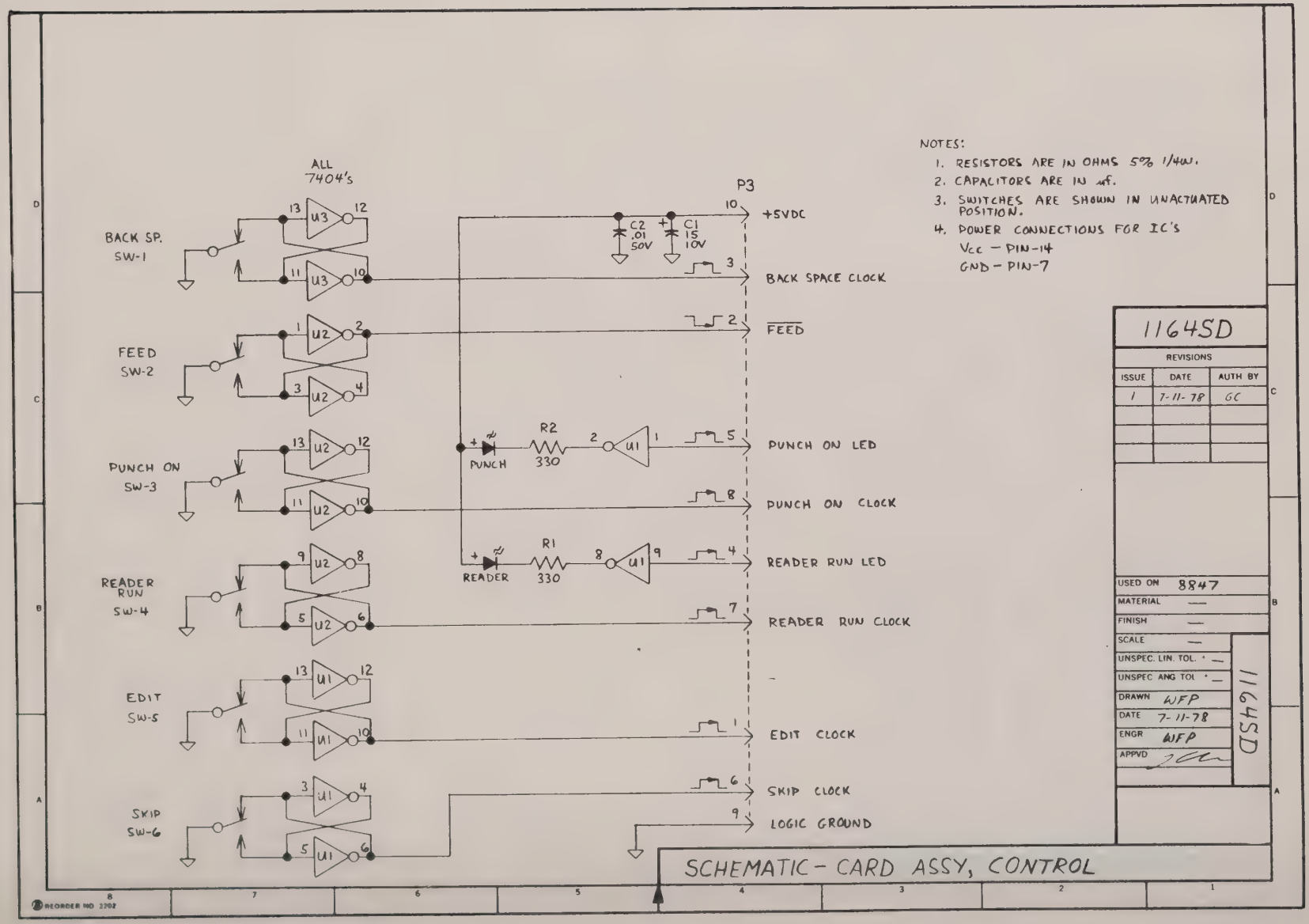
Schematic - Logic Board Assembly, Selector Module Latch and Drivers

Figure 4-11i

5. CONTROL CARD ASSEMBLY

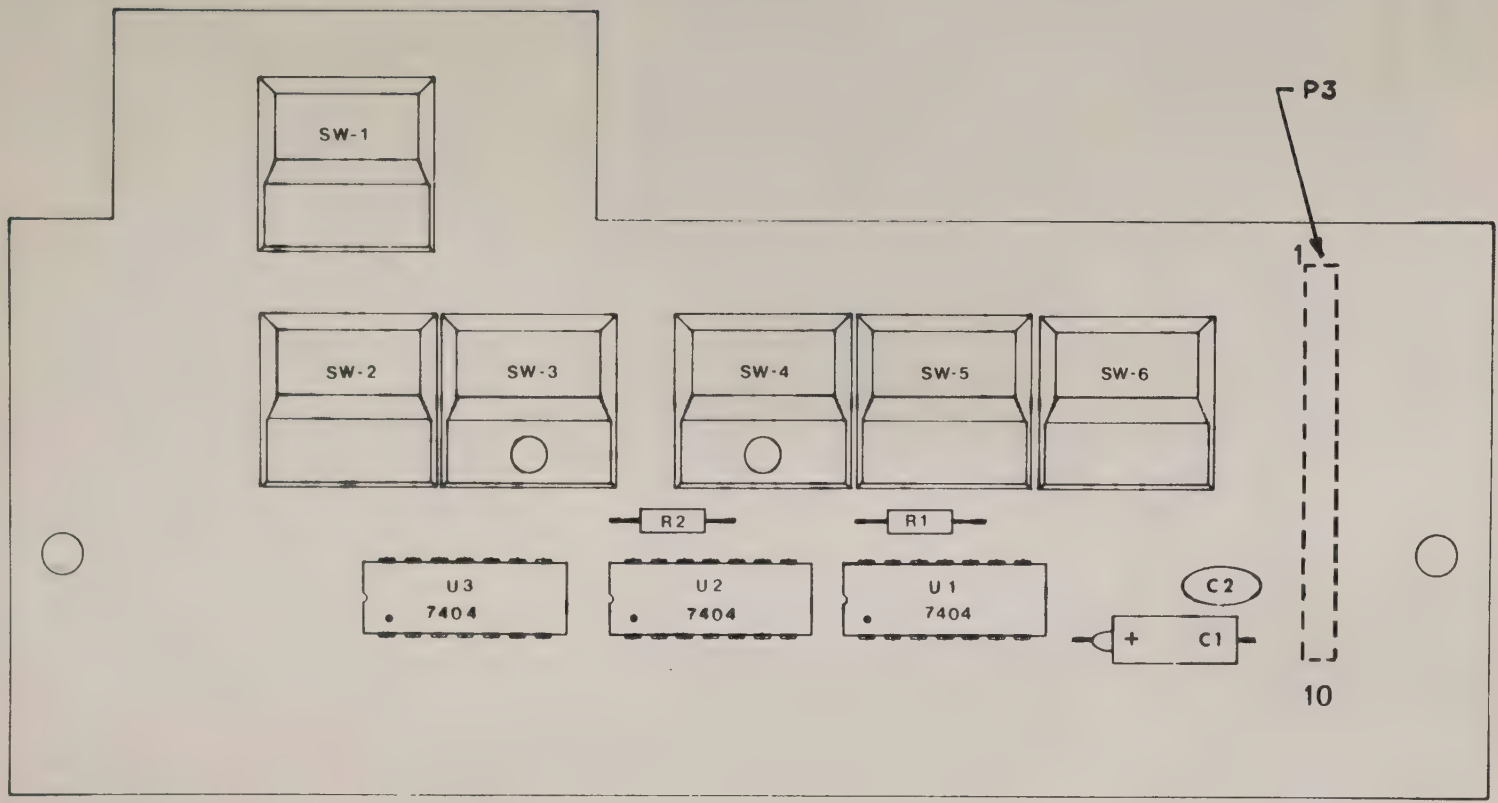
Refer to Figure 5-1, schematic. The control card plugs directly into the logic card and provides control switches for activation of the punch and reader. These switches are momentary pushbutton types which feed into cross coupled gates in order to debounce the switch contacts. When the switch is pressed, logic ground is removed from the signal line. The action of the cross coupled gates serves to drive the signal line high (logic '1') and maintain it even though the switch contacts bounce. The FEED circuitry uses the opposite gate for the signal line and therefore provides an inverted signal output.

The READER RUN and PUNCH ON pushbutton switches have an integral LED which indicates that the particular function is ON. The LED's are driven by TTL gates which derive their signals from the logic card. Since actual tape movement indicates response to the BACK SPace, FEED, EDIT and SKIP functions, LED's are not necessary. Following the schematic is Figure 6-2 which shows the assembly and component locations.



Schematic - Control Card Assembly

Figure 5-1



Control Board Assembly

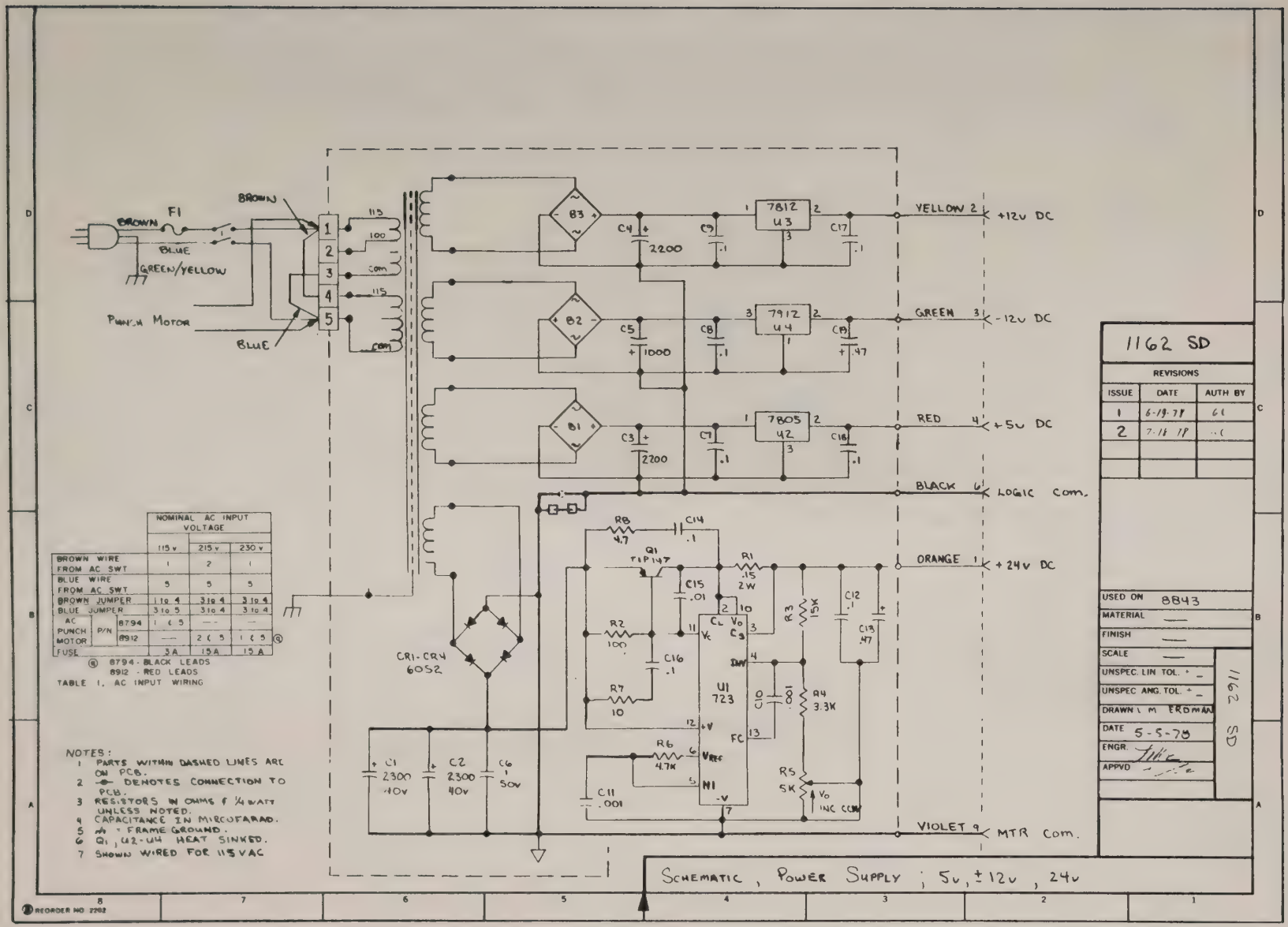
Figure 5-2

6. POWER SUPPLY

6.1 CIRCUIT DESCRIPTION

Refer to Figure 5-1, schematic. The power supply is the terminus for all AC line connections as well as the source for the several DC voltages required to operate the 901-1951. The AC line voltage is stepped down, rectified, filtered and regulated to the desired voltage. Transformer T1 provides a dual primary winding for 215 or 230 VAC operation and several isolated secondary windings. Rectification is accomplished by bridge rectifiers B1, B2, and B3 for the +5V, -12V, and +12V supplies while power tab voltage regulators U2, U4, and U3 provide the actual regulated voltages.

The +24V supply voltage utilizes an IC voltage regulator and pass transistor element in order to provide the necessary drive current for selector coils and stepper motors. Diodes D1-D4 bridge rectify the AC voltage and C1 and C2 filter this to provide a raw unregulated DC voltage to the regulator. To explain operation of this regulator, refer to Figure 6-2. The figure shows the internal elements of U1, zener diode Z1 provides a reference voltage which is stabilized by a constant current source and buffered by amplifier A1. This reference voltage is fed to the non-inverting input of error amplifier A2. The inverting input of A2 is a portion of the output voltage divided down by R3, R4 and R5; R5 provides a means of adjusting the voltage by changing the string's total resistance value. Error amplifier A2's output will rise to meet any detected decrease in output voltage, thus driving QA which in turn drives Q1. R1 is a low series resistance which, when an excessive current is being provided, develops sufficient voltage drop to cause QB to conduct causing QA and Q1 to drop the output voltage to a preset maximum level.



	NOMINAL AC INPUT VOLTAGE		
	115 v	215 v	230 v
BROWN WIRE FROM AC SWT	1	2	1
BLUE WIRE FROM AC SWT	5	5	5
BROWN JUMPER	1 to 4	3 to 4	3 to 4
BLUE JUMPER	3 to 5	3 to 4	3 to 4
AC PUNCH MOTOR P/N 8794	1 & 5	—	—
AC PUNCH MOTOR P/N 8912	—	2 & 5	1 & 5 ⑥
FUSE	3A	1.5A	1.5 A

⑥ 8794 - BLACK LEADS
8912 - RED LEADS

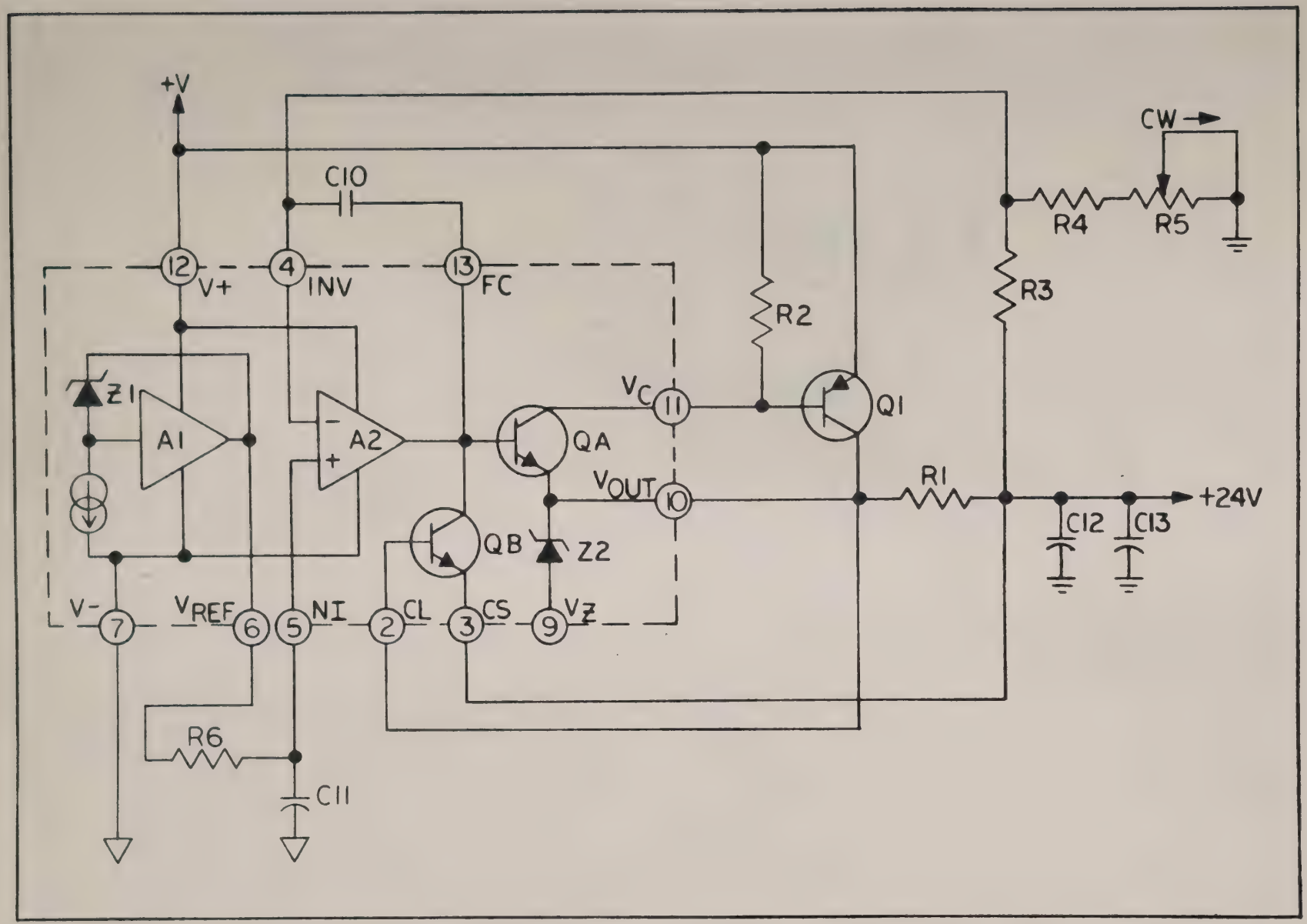
TABLE 1. AC INPUT WIRING

NOTES:
1. PARTS WITHIN DASHED LINES ARE ON PCB.
2. ⊸ DENOTES CONNECTION TO PCB.
3. RESISTORS IN OHMS ± ¼ WATT UNLESS NOTED.
4. CAPACITANCE IN MICROFARAD.
5. ⏚ = FRAME GROUND.
6. Q1, U2-U4 HEAT SINKED.
7. SHOWN WIRED FOR 115VAC

REORDER NO 2702

Schematic - Power Supply

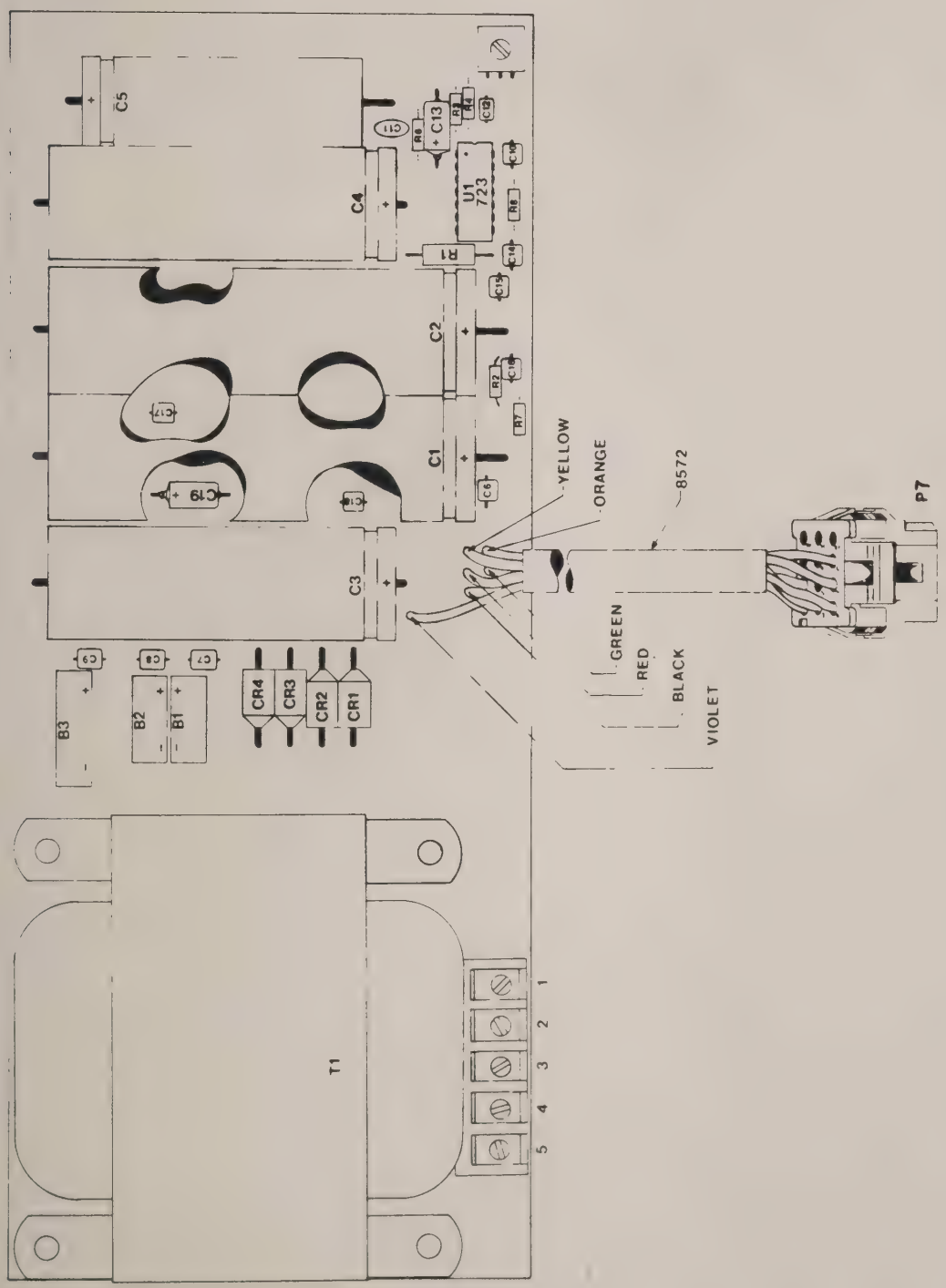
Figure 6-1



026-1951

+24V Supply

Figure 6-2



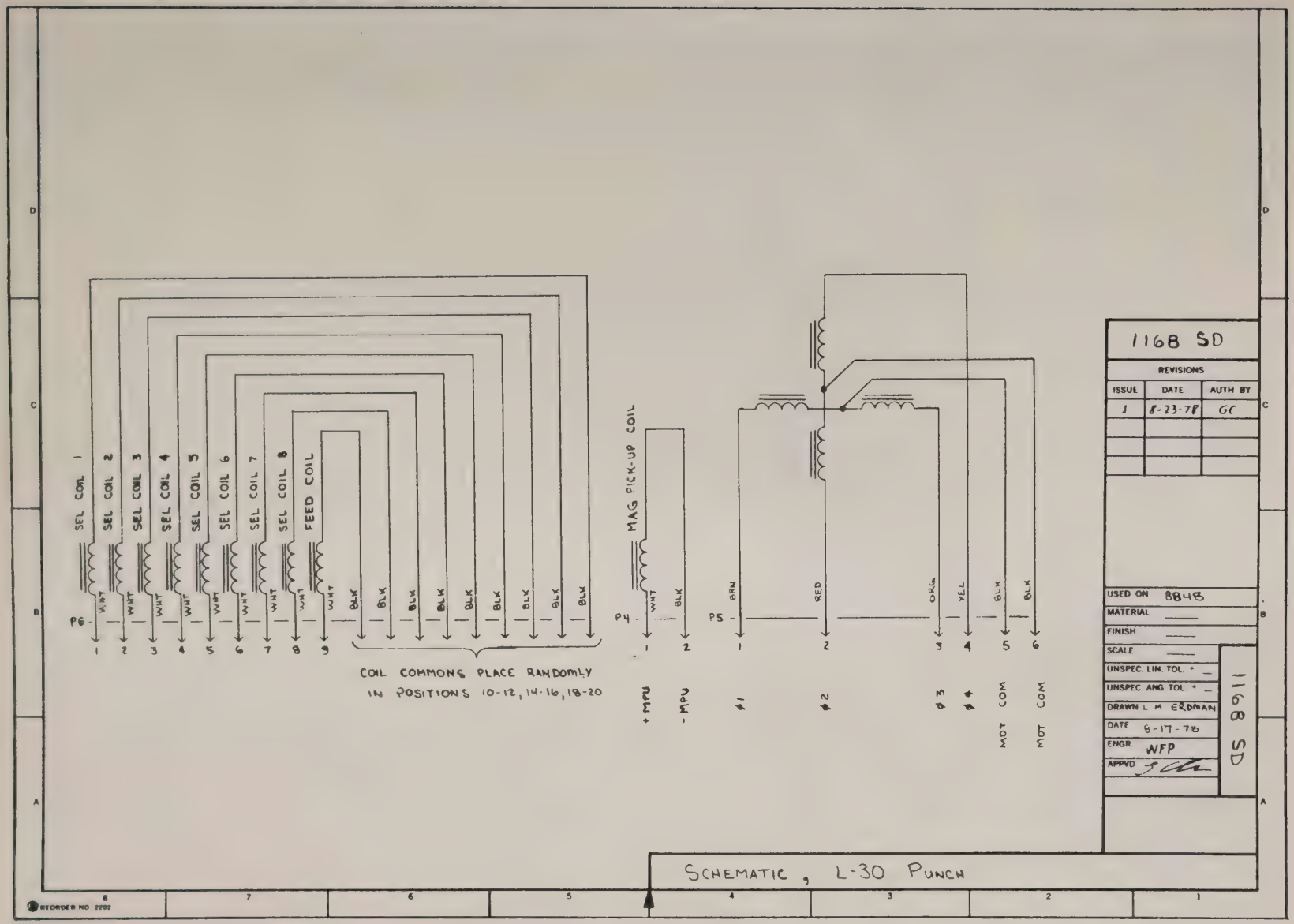
Power Supply PCA

026-1951
6-4

Figure 6-3

7. PUNCH MECHANISM, L30B

All the information regarding the operation, preventive maintenance and corrective maintenance for the punch, is contained within the MODUPERF maintenance section of this manual (Part 2). The schematic diagram provides a condensed electrical connection scheme for each of the punch mechanism modules.



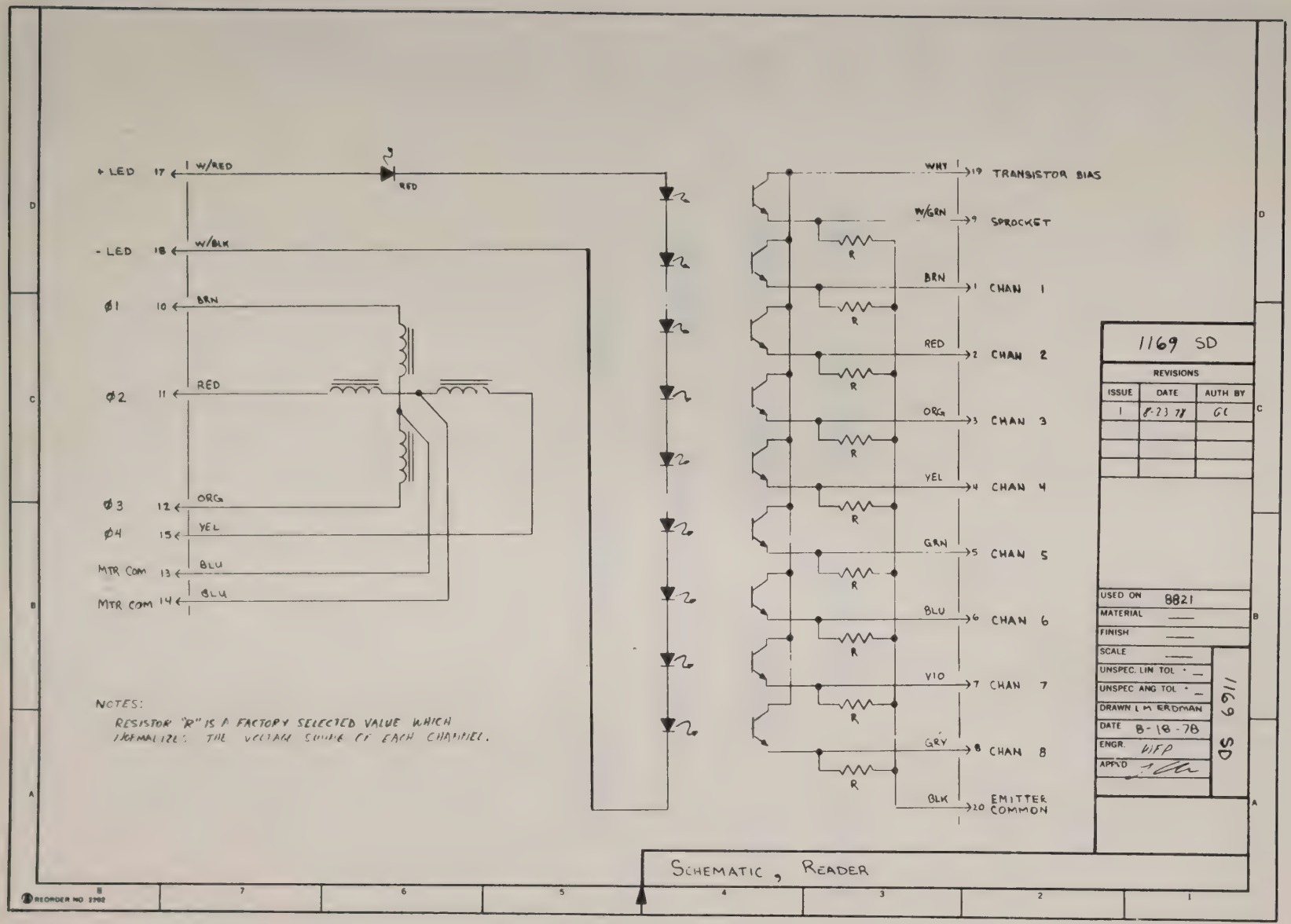
Schematic - Moduperf, L30B

Figure 7-1

8. TAPE READER

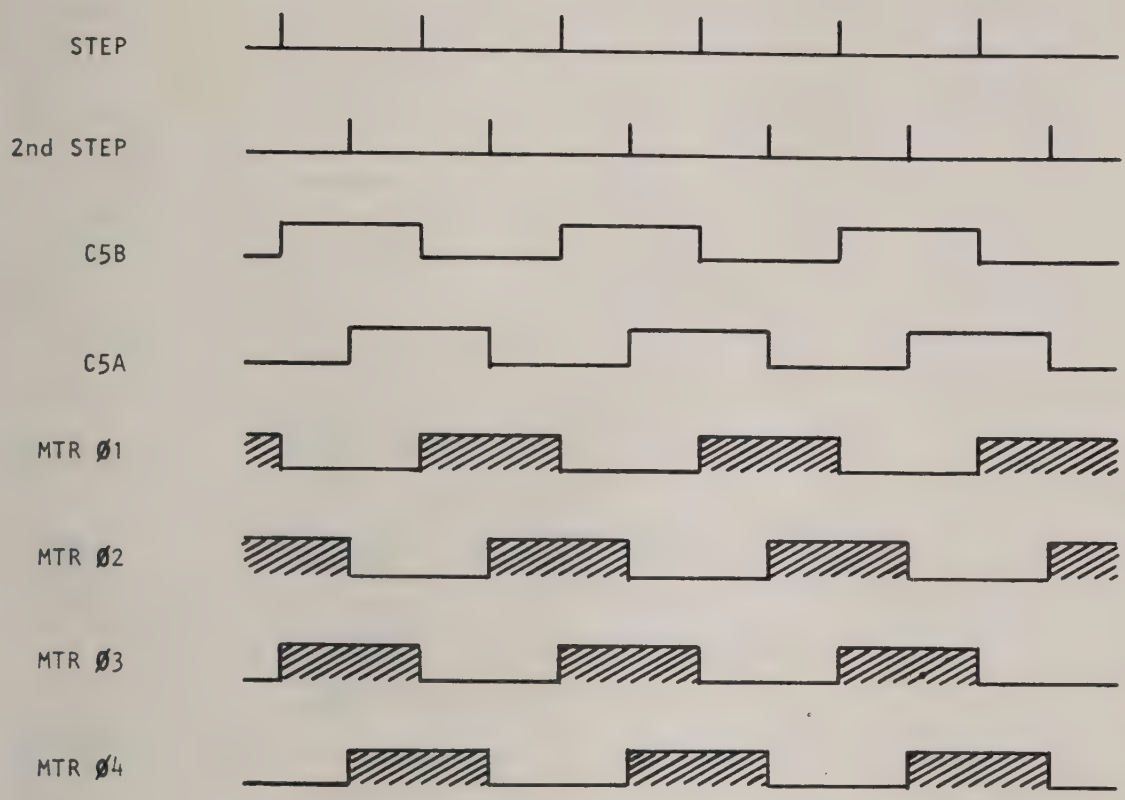
Refer to Figure 8-1, schematic. The Tape Reader used in the 901-1951 is a high speed precision mechanism which is capable of running at any speed within the 45-300 baud range. It utilizes infrared LED's (light emitting diodes) as the light source. The LED's require 30mA at 24V to provide an adequate light source for proper tape reading. This infrared light is passed through the holes in the tape being read and is picked up by photo-transistors in the base of the unit. The phototransistors detect the presence of light and provide a voltage equivalent signal for all eight data channels (or levels) and sprocket/feed hole.

The stepping motor is activated by circuitry contained on the Logic Card Assembly. The motor itself is a 4 phase 7-1/2° stepping motor used in a bi-phase mode of operation; that is to say that only 2 of the 4 phases of the motor are driven at one time. Refer to Figure 8-2, timing diagram which shows motor operation. For each step pulse, one of the motor phase driven transistors cuts off and another turns on; note that the motor phases are driven 1 and 2, 2 and 3, 3 and 4, 4 and 1, etc., sequentially in that order. As long as the reader is on, the motor common is held at a 24V level; when the end of tape is detected, motor common reverts to a standby voltage (+12V) to hold the stepping motor in position but at a lower power level.



Schematic - Tape Reader

Figure 8-1



Reader Stepping Motor Timing

Figure 8-2

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